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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTION OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION

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NOTES AND COMMENTS.

The Triplex Process.

This process, as applied to the manufacture of malleable cast iron, is dealt with on page 95 by Mr. H. A. Schwartz, who has specialised in the metallury of malleablising. A careful perusal of the article has failed to convince us of the necessity for the inclusion of the converter. Its function, according to the writer, is the removal of the carbon, manganese, and silicon, which have only to be put back again during the third—the electric furnace—stage of the process. We agree that the oxidation in the converter of the elements mentioned furnish many heat units, but it should be taken into consideration that just as many heat units are used up for the reduction of these elements into the form of ferro-alloys and for their melting and assimilation by the metal.

Whilst the elimination of carbon, silicon, and manganese from pig-iron evolve heat, so does their assimilation by the metal require heat.

It will be noticed that, of the five elements dealt with, four are subject to adjustment; the fifth—that is, the phosphorus—must be according to specification in the original cupola charge. We suggest that since the electric furnace is *per se*, capable of chemically reducing the sulphur, augmenting the carbon, silicon, and manganese by suitable additions, and reducing the last three elements by dilution with steel scrap, it is quite possible to meet any specification cheaply by the purchase of suitable raw material in the open market, for even with the triplex system a check has to be kept upon the phosphorus content.

We put forward a duplexing system on the following grounds:—(a) Lesser capital, (b) lower labour and maintenance costs, (c) increased efficiency, and (d) increased output.

Dealing with each case specifically, it should be pointed out that the installation of a cupola, a Bessemer converter, and an electric furnace would place upon each cwt. of castings such a plant-depreciation charge, which would be so high that, unless the whole plant could be kept for very long periods at the highest pressure, it would render it impracticable. Even omitting the converter, the first cost would still be the deciding factor for the installation of such a system. The second factor, that of lower labour and maintenance costs, is based upon the absence of the second unit—the converter—whilst the third is due to the elimination of the waste associated with the Bessemer, and loss of heat, time, and material taken up by the extra transference. Whilst theoretically output should be greater with the triplex process than with the duplex, providing the units are correctly chosen, in practice, a breakdown in any one of the three plants holds up the other two, leaving two gangs of workmen unemployed or employed upon non-productive, yet possibly expensive, work. Finally, we are of opinion that the triplex process offers no advantage over the duplex, as all the control of elements can be effected equally as well by the latter as by the former.

Institution of British Foundrymen—Annual Conference.

We are informed by the General Secretary of the Institution of British Foundrymen that a leaflet outlining the details of the Blackpool Conference has been posted to all members, associate members and associates. These will be found to be virtually the same as given in these columns last week, but with the important exception that the directors of Messrs. Joseph Stubbs, Limited, of Manchester, the firm with which the President-Elect, Mr. Oliver Stubbs, is associated, have invited the members to lunch at the Furness Abbey Hotel, Barrow, on the last day of the Conference. The full programme will be given in the next issue of THE FOUNDRY TRADE JOURNAL.

The Council are to be congratulated on the adequate arrangements made, and the success of the meeting is already assured.

A NEW METHOD FOR DETERMINING THE DUCTILITY OF METALS.*—The author suggests a simple and easily applied test for ascertaining the limits of tenacity and ductility of a piece of structural iron or steel, which does not involve the preparation of test pieces. The results afforded are only approximate, but are sufficiently accurate for most practical purposes. The test is useful where deformation, or a degree of deformation, is in question. It consists in the application, under a press, of a hardened-steel cone, the point of which forms an angle of 90 degs., as used in the ordinary tests for hardness. The pressure is applied near the edge of the metal to be tested, and is gradually increased until the cone penetrates the metal sufficiently to start a rent. This is the principle of the test. The author discusses its theory, and tabulates the results of numerous experiments made on various qualities of steel, and on some other metals.—P. LUDWIK (*Stahl und Eisen*).

* Inst. C.E. Foreign Abstracts.

Notes on Enamels for Cast Iron.

BY NEVILLE DEANE.

In the manufacture of cast-iron articles, there are probably no secrets more closely and jealously guarded than those relating to the production of a high-grade enamelled finish. The firm which is fortunate enough to possess the formula for a really excellent enamel is to be congratulated, since all the properties of the ideal enamel are exceedingly difficult to combine in the same product.

The ideal enamel should be thin, highly glazed, of a good colour, proof against the action of water and acids, and, if possible, dilute alkaline solutions. It should be hard, yet not easily chipped, and must be able to withstand changes of temperature.

In this article it is proposed to give the results of some small researches into the effect of different constituents upon the final enamel. It should be stated at once that there are two entirely different classes of enamel. The first is merely a groundwork or preparation for the enamel proper, but it must be understood that a poor or unsuitable "glaze" or "matte" or "ground" enamel will ruin an excellent cover enamel, and will also cause a great deal of confusion as to whether the enamel or the ground is at fault. Time, unfortunately, did not allow of researches or investigations of the ground or matte, but only in the direction of the enamel itself.

An enamel may contain any or all of the elements aluminium, calcium, sodium, potassium, magnesium, boron, silicon, tin, fluorine, oxygen and metallic oxides for colouring, which are introduced in the form of various minerals and chemical compounds. These include quartz, flint, felspar, fluorspar, cryolite, calcspar, borax, sodium bicarbonate, powdered glass, saltpetre, clay, magnesium carbonate, tin oxide and, perhaps, other materials in small quantities.

An analysis of an enamel will not reveal the original mixture before fusion, not only because some volatile portions, such as CO_2, water of crystallisation, etc., are lost, but also because the same element may be found in two or more of the original constituents; and, further, because various additions are made during the grinding of the fused enamel. The secrecy of an enamel formula is thus assured.

The influence exerted by various materials used was carefully investigated, and may be of use to other workers.

Quartz, flint or sand, which are nearly pure silica, are used as one of the principal ingredients in most enamels. It has the effect of raising the melting-point, increasing the acid-resisting qualities and the ability to withstand changes of temperature, but, unfortunately, it has a deleterious effect upon the "gloss" of the enamel. It is used to raise the percentage of silica (SiO_2) in the enamel should the other materials contain insufficient, and is the most refractory of all the constituents.

Felspar is a natural compound of silica, alumina, soda and potash, and is of the greatest service to the mixer. It should be regarded as a refractory material owing to the large amount of silica it contains—usually about 65 per cent.—but is less so than quartz itself. Owing to its complex character it is a good acid resister, despite the alkalies it contains, whilst its other properties are those of quartz in a modified degree.

Borax is largely used as a flux, in the manufacture of the enamel. It is excellent for its purpose, having the effect of lowering the melting-point and imparting a high gloss, but produces, when used in excess, an enamel which is easily disintegrated by weak acids, or even water. It must, most emphatically, be used with the utmost caution for any enamel which is required to be at all acid-proof.

Sodium bicarbonate is necessary to contribute the soda (Na_2O) it contains as a flux. It is very good as a flux, being better than borax, since it actually combines with the silica, but does not give such a highly glossed surface, and it also appears to upset the coefficient of expansion, so that the enamel cracks or "flies" after firing. A suitable alteration in the "ground" enamel or "matte" would be necessary to counteract this tendency.

Since soda is present in felspar, it is usually unnecessary to add any considerable quantity of the bicarbonate to the mixture.

Cryolite is a main factor in securing opacity, producing an opaque white colour. It actually dissolves in the enamel, which appears clear when molten, the white colour gradually coming up as the enamel is cooling down. It will not of itself give a sufficiently opaque white for making a "swill" enamel to be put on in two coats, but might be used if a "dusted" enamel only is required.

It is a double fluoride of aluminium and sodium, and contains a small percentage of silica. Cheap artificial cryolites contain more silica, so that a larger quantity is necessary to produce the same effect. Not more than 15 per cent. should be used in any mixture, owing to the fact that cryolite gives a dull surface, and has a considerable influence upon the contraction, whilst too small a quantity gives little or none of the desired opacity.

No better material for giving an opaque white has been found than tin oxide, especially if used in conjunction with cryolite, but owing to its high cost it must be used with discretion. If added to the mixture before melting some may dissolve and be lost; consequently it is better to add the bulk of the oxide whilst grinding in the mill. It should be borne in mind that, if this is done, very thorough grinding is necessary to avoid patchiness, and also the finished enamel will be duller and less fusible than the original melt.

Other materials are used in small quantities only, and need less comment.

Calcspar introduces lime, which gives a better contraction, and also a more complex and acid-proof enamel. Glass acts in a similar manner, but owing to its uncertain composition must be used cautiously. Magnesium carbonate and clay are refractories, and appear to add a little to the whiteness of the enamel if melted in. They are also used as additions in the mill when making a "swill" enamel to enable the ground enamel to hold up in the water.

Saltpetre is a flux, due to the contained potash, but is used mainly owing to its oxidising influence, which helps to clear the enamel of impurities during melting. Fluorspar is more used in the "matte" than in the enamel proper, and has the effect of making the enamel adhere to the iron.

In conclusion, there is ample room for a thorough investigation into the whole question of mixtures in a scientific manner.

A CORRECTION.—In the last issue of THE FOUNDRY TRADE JOURNAL, we omitted to credit the *Canadian Foundryman* as being the source of origin of the article entitled "Moulding Elbows with Green Sand Cores."

ELECTRIC TRUCK FOR MOULDING SAND.—According to the "Iron Age" extensive tests have recently been made by the Yale and Towne Mfg. Company, Stamford, Conn. with a view to ascertaining the exact economy effected by the use of electric storage battery trucks. Accurate records were first made on the cost of handling 600 tons of moulding sand from a wagon on the railway siding to the moulding floor in the foundry, 200 ft. away. Forty feet of this distance was a 12 per cent. gradient up a concrete ramp, with a sharp, right-angle turn at the top. It took 18 men with wheelbarrows and shovels, 6 days, working 9 hours per day, to transfer the 600 tons of sand. The total cost was $545.72 (nominally about £113 10s.)

A few weeks later another 600 tons of the same sand, delivered by car to the same point, was transferred to the moulding room by means of a Yale electric truck equipped with a standard detachable end-dump body of 27 cu. ft. capacity. With one man driving the truck (one member of the former wheelbarrow gang) and an extra man with a shovel to help load the truck, this 600 tons of sand was transferred in four 9-hour days, at a total cost of $183.60 (nominally about £38 5s.)

Casting Large Pipe Fittings.*

By James J. Zimmerman.

Though the Scott Foundry, a branch of the Reading Iron Company, of Reading, Pa., U.S.A., is similar to any other modern plant, it differs very substantially, however, inasmuch as it operates two cupolas and three air furnaces, in which rolls and special high-grade castings, which require high strength and corresponding physical properties, are made.

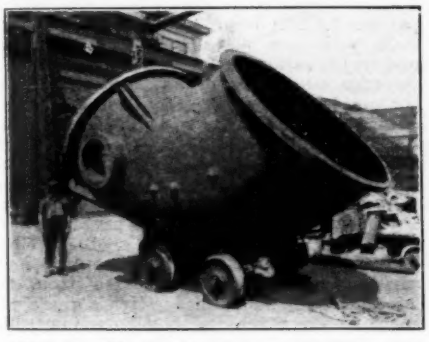


FIG. 1.—ELBOW CASTING WEIGHING OVER 12 TONS.

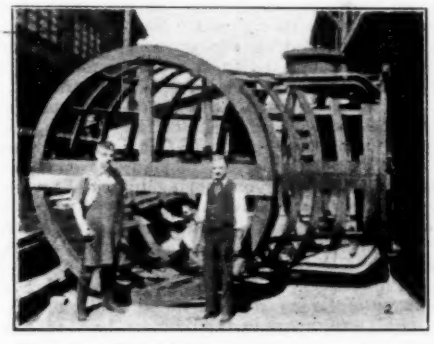


FIG. 2.—THE SKELETON PATTERN USED FOR THE CONSTRUCTION OF THE CASTING SHOWN IN FIG. 1.

Recently this company contracted for the supply of a number of large pipe fittings for the 96-in. exhaust line of a 10,000 kw. installation, which consisted of a number of special fittings, reducers and elbows.

The elbows, as shown in Fig. 1, were made from cast iron with walls 1½ in. thick, and weighed 12 tons 6 cwts. each in the rough. The flanges were finished 2¼ in. in thickness by 9 ft. in diameter. A 2-ft. outlet can be seen, and also four suspension lugs. The radius on the neutral axis is 94 1-16 in.

*Extracted from the "Blast Furnace and Steel Plant."

Patterns.—A skeleton pattern shown in Fig. 2 was used for making the mould and the core. It was accurately made and split in halves, and was used as such, half for the cope and top half of the core and half for the drag and bottom half of the core.

The suspension lugs and side outlet nozzle were separate pattern, and were pinned on to the main pattern, in order to withdraw them separately from the cope and drag. The flange on the outlet nozzle was made in sections in order to permit its being picked from the drag. The slot in the suspension lugs was cored and necessarily required a core box, as did the core for the nozzle.

The crab, or grid, was made from a pattern, while all other fixtures, such as plates, flask sides, etc., were open sand castings, and consequently required no patterns.

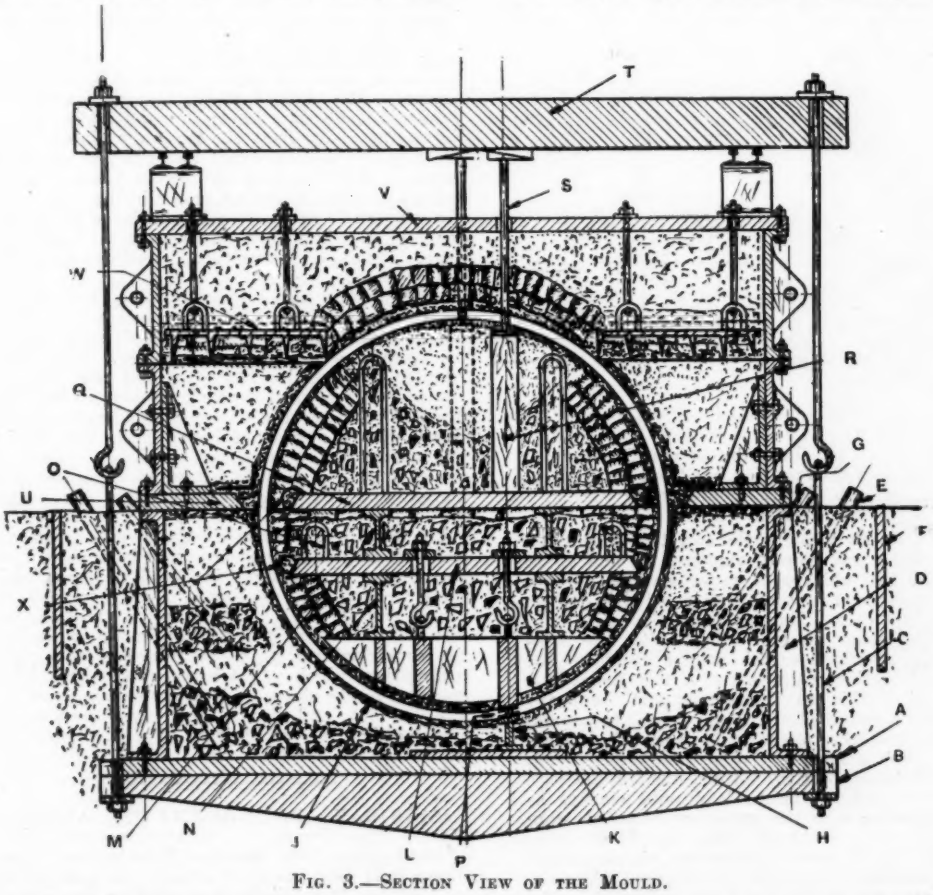


FIG. 3.—SECTION VIEW OF THE MOULD.

In constructing the mould the procedure was as follows:—First, the drag; second, the bottom half of core; third, the top half of core; fourth

the bottom section of cope; fifth, the top section of cope.

This is illustrated best by sectional view Fig. 3. After the hole in the floor was dug to a depth of about 7 ft., the plate (A), in two sections, which covered the entire bottom of the mould, with six beams under it, through which the 1¼-in. tie rods (C) ran, was levelled up. Next the standards or cope supporting columns (D), of which there were six on each side of the mould, were placed in position and the initial part of the drag was begun by spreading a bed of cinders over the entire bottom and placing the deep vent pipes (E). These deep vent pipes were 4 in. in diameter, and numbered three on each side and two on each end of the mould. Next a temporary shoring, approximating the outside diameter of the pattern, was placed in the drag, in the position which would later be occupied by the pattern, and the drag filled in with sand and cinder and rammed up. This included the placing of the 3-in. upper vent pipes (G), of which there were three on each side and two on the ends, as well as the reinforcing or shoring plates (F), also the setting of the chaplet supporting standards (H), of which there were three placed 10 in. away from the centre line of the elbow, as shown in Fig. 4.

Next the temporary shoring was torn away, and a layer of facing sand, denoted by letter (J), was spread and upon it the bottom half of the

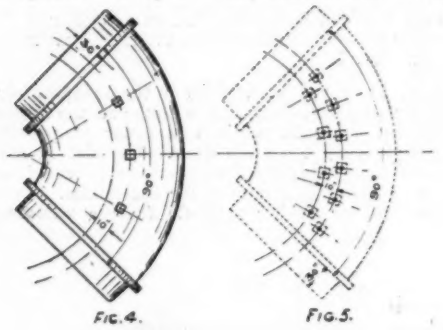


FIG. 4.

FIG. 5.

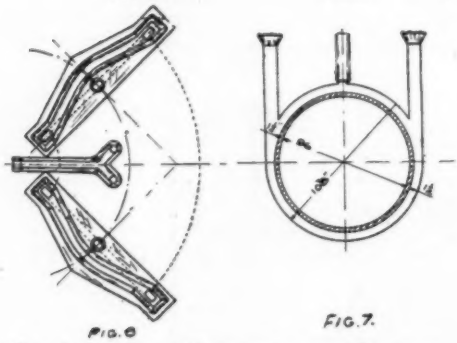


FIG. 6

FIG. 7.

FIG. 4 SHOWS THE POSITION OF THE CHAPLETS, FIG. 5 THE POSITION OF THE ANCHOR RODS, FIGS. 6 AND 7 THE POSITION OF GATES, RUNNERS AND RISERS.

skeleton pattern with nozzle and two suspension lugs on same was placed, rammed up and swept off. Upon this a layer of paper was placed, and work begun on the construction of the bottom half of the core. This part of the work was begun by placing the crab (K) so that the three lugs came directly over the chaplet standard (H). The chaplets then came between two metal surfaces, and in this way helped support the heavy core and maintained an even space for metal which formed the elbow. Between the mould and the crab a layer of facing sand was spread, and upon it the entire bottom half of the core was constructed of brick, loam and cinder, as shown together with the cast-iron plate (L), standards (M) and (N), hook bolts and lifting eyes (O). It is to be noted that so far all the weight of the core was supported on the metal plate (A) through the standard (H), chaplet (P), crab (K), standard (N) and plate (L), and that no weight was thrown on the sand mould except on the core prints, which are shown in Figs. 4 and 5, which were the same diameter as the core itself and extended beyond the faces of the flanges into the cope and drag on each end for a distance of 30 inches. Vent pipes not shown were run from each end of this lower section of the core to the floor line.

Next the top half of the core was built up by placing the cast-iron plate (Q) provided with lifting eyes directly on the lower half of the core, and building up with brick, loam, cinder and facing sand. The hay rope (X) at sides of plate (Q) and plate (L) in lower half is introduced to permit of the contraction of the elbow after pouring without fracture or harm. When the top half approximated the required size, the top-half of the skeleton pattern was placed over it and the core was swept off and finished to the outside diameter of the pattern. The 6-in. square wooden anchor posts (R) with iron plates upon them, with the anchor-iron (S) in turn upon them, were run up to the spreader beams (T), of which there were six and through which the rods (C) passed on down to the bottom beams (B), thus tying the entire mould together. These anchors were forced down tight by means of wedges, thus preventing the core from swinging upwards and assisting the core prints in keeping the entire core down. In this way any movement of the core was prevented, and the required thickness of the walls of the elbow obtained without distortion. The object of the wooden posts was that they charred from the heat of the metal and crushed. Hence there was no chance of the elbow cracking on cooling, due to contraction or shrinkage. It will be noticed that both halves of the core are held down solidly, the bottom half by the top half, and the top half as follows, beginning with spreader beams (T) through the wedges, then the anchor irons (S) on through the plates and wooden posts (R) to the plate (Q), which rests on the bottom half of the core, with the core prints of course taking their portion of the work. These anchors were ten in number, four of which were on the centre line of the elbow and six on a line 10 inches off all as shown in Fig. 5.

A glance will show how the cope, which rested on a solid cast-iron plate (U), and which was covered by a cover plate (V), which was in two sections, was constructed of sand, loam and brick but no cinder. The parting of the two sections of the cope was made on a line where the crabs (W) are shown suspended from the top cover plate. Next the mould was torn apart and finished after the pattern, including lugs and outlet pieces, was removed. After finishing and slicking the faces, the cope and cores were taken to large core ovens for drying, while charcoal fires were built in the drag. Thus, comparatively the elbows were dry-sand castings.

After drying, the cores, including those for the outlet nozzle and suspension lugs, were set and the entire mould was assembled, and all rigging such as tie-rods, etc., tightened securely. The risers, runners, pouring basins, gates and pop gates or run-overs were then formed, as shown in Figs. 6 and 7. Next the entire mould was weighted down, with a number of heavy chills, etc., which approximated 140 tons, computed, of course, on the theory that a body immersed in a liquid is buoyed upwards by a force equal to the weight of the liquid displaced.

The pouring was done simultaneously from both ends of the mould and through four gates (two on each flange), as shown in Fig. 7. Immediately after pouring and settling the weights were removed and as much of the mould as possible was torn down, and the sand portion in the top half of the core dug out, so as to relieve strains from contraction, which might have caused checking or cracking of the elbow. After four days the elbow was dug out, and cleaned and transferred to the machine shop for machining. Fig. 1 shows it on its way to the machine shop.

AMERICAN FOUNDRYMEN'S ASSOCIATION.—According to a recent announcement issued by the secretary, the American Foundrymen's Association will hold its next convention and exhibit in April or May, 1922, at a place to be selected later. At a meeting of the board of directors it was recommended that the convention be held at New York City in October this year without exhibits. It was ultimately decided, however, to hold the convention with exhibits next spring.

The Re-arranged Steel Foundry of the Chicago Foundry Co.*

By Gilbert L. Lacher.

To modernise and enlarge a foundry in such a manner as to get the most out of existing facilities and to so co-ordinate them with those of the addition to secure maximum production at minimum cost, constitutes a more difficult problem than constructing an entirely new plant. Further complexities are added when expansion must be accomplished with due regard to the maximum future development of the property. All of these considerations were involved in remodelling the plant of the Chicago Steel Foundry Company, Chicago. A study was first made of the original works, to determine whether it could be developed to maximum productive capacity without constructing additional buildings. Investigation disclosed that the best results could not be obtained, because a number of departments were overcrowded and too small, thereby limiting the output of other parts of the plant. It was therefore decided to construct an addition to the foundry and to change the position of certain departments. At the same time it was determined to install an electric furnace to replace the cupolas and converters.

The furnace is of the removable top type and was constructed by the Industrial Electric Furnace Company, Chicago. It has a rated capacity of 3½ tons, but as much as 4½ tons have been tapped from it. Its average consumption of electricity per ton is 600 kwh. and the lowest consumption per ton, thus far recorded, was 480 kwh. In 150 consecutive operations the time of the first heat averaged 2 hr. 37 min., for the second heat 2 hr. 7 min., and for the third heat 1 hr. 55 min. The best time achieved up to date was 1 hr. 15 min. The removable top has reduced charging time materially. Before each heat the top is lifted back by an electric motor, a drop bottom bucket is lowered by an overhead travelling crane, and the charge dropped into the furnace. The average charging time is less than 5 min., whereas a trial of hand charging through the side charging doors of the furnace disclosed an average time consumption of 20 min.

Current for the operation of the furnace is brought untransformed from the Commonwealth Edison Company, Chicago, and is stepped down by a 1,500-kva. Pittsburgh Transformer Company transformer to either 180 or 90 volts. The transformer room is entirely enclosed and admittance is granted only to those who are authorised to enter. All high tension equipment is carefully guarded.

The furnace is equipped with three 7 in. graphite electrodes, each of which is raised and lowered independently of the others. The electrodes are held in cranes which operate in vertical slides and may be controlled either by hand or automatically by electric motor. At the Chicago Steel Foundry plant it has been found that the best results are obtained by regulating the electrodes by hand wheel for about ten minutes before throwing over to the automatic control. Each electrode crane is served by a 2-h.p. General Electric d.c. reversing motor. The motor is connected with a cable drum and, by winding or unwinding the drum, raises or lowers the electrode crane. The height of each crane, hence the position of the electrode in the furnace, is automatically regulated by the amount of current flowing. As a safety measure automatic stops have been provided, both at the top and bottom of each slide, to disconnect the motor when the crane reaches those points. The automatic push button control for raising and lowering the electrode crane was furnished by the General Electric Company.

The electrode-holders are water-cooled and may be tightened or loosened by worm gears from the back of the furnace. Thus the operator is protected from the heat.

The 90-volt current is used for refining, better results being obtained with shorter arcs than with those used for rapid melting.

At the conclusion of a heat the furnace is tilted for tapping by rack and pinion, operated by a 3-h.p. General electric motor. As many as 14 heats, yielding a total of 50 tons, have been obtained when operating the furnace 24 hr., while 21 tons have been melted in an ordinary day shift. When the furnace was first put into operation on December 20, 1920, it was primarily to give the installation a preliminary trial. Operation has been practically continuous since that date and the electric furnace has been used exclusively for steel production in the foundry, whereas the cupolas and converters have been abandoned. A minimum of repairs has proved necessary. It is thought that the design of the furnace is conducive to its longevity. The roof of the furnace is exceptionally high and to that fact is attributed the freedom from torn down linings.

The electric control panel containing the oil switches controlling the transformers and the push buttons operating the elevating motors, etc., was furnished by the General Electric Company. A safety switch, by which all current may be shut off in an emergency, was supplied by the V. V. Fittings Company, Philadelphia.

To increase the output of the electric furnace the Chicago Steel Foundry Company is installing an oil-fired preheating furnace of special design. Scrap will be elevated in buckets along a runway, similar to the skip hoist on a blast furnace, and will be charged into muffles, through which it will pass by gravity through the preheating furnace. After preheating, doors will be opened at the discharge end of the muffles and the preheated scrap will be discharged into drop bottom buckets, which will be lifted by overhead crane for charging the electric furnace. The preheater is also being furnished by the Industrial Electric Furnace Company, Chicago. On the basis of results obtained with preheaters elsewhere, the manufacturer expects the preheating to increase the output of the furnace 50 per cent., and to reduce the electrical consumption 40 per cent., so that 3-ton heats can be obtained every hour, including charging time.

The enlargement of the foundry involved making material changes in the departmental arrangement. A study of the original works disclosed the fact that the moulding area and the melting equipment were ample for a production of 315 tons of castings per month, but the size of the core room and the capacity of the core oven were inadequate for this output. It was found that the cleaning department was too small and material handling through this department was costly. The department to which the castings were brought from the foundry for sand blasting and tumbling, formed a pocket. Only a 10 ft. passageway was available for the movement of castings from the sand blast and tumbling department to the grinding, chipping and welding room. Here lack of sufficient space caused congestion around the grinders. The dispatch department adjacent to the cleaning department had no facilities for rail shipments and all finished castings for shipment by rail had to be trucked 180 ft.

The engineers therefore decided to extend the foundry building proper 140 ft. and to house in this addition all cleaning and finishing equipment. A spur from the railroad adjacent to the plant was extended into the end of this structure to make possible loading of shipments into cars under the plant roof. The building which had formerly

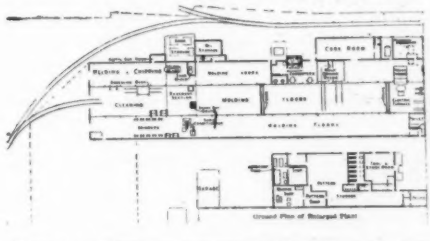


FIG. 1.—THE RE-ARRANGED FOUNDRY OF THE CHICAGO STEEL FOUNDRY.

* Extracted from the "Iron Age."

contained the cleaning and shipping departments was remodelled to provide more room for pattern storage, machine shop, tool and store room, carpenter shop and pattern shop.

The addition to the foundry building proper was constructed in such a manner that the craneway could be extended, but differed somewhat in design in that the roof over the main bay was built higher than the old roof to provide better ventilation and lighting. The roof over the main bay of the old structure was not high enough in proportion to the side bays to insure proper ventilation. The roof was therefore raised to allow for additional sash and was made to conform to the design of the addition as nearly as possible.

A feature of the addition is the sand conditioning equipment. This was designed by the C. O. Bartlett and Snow Company, Cleveland, in cooperation with the engineers. To promote the freest movement of sand to and from the conditioning equipment the engineers recommended flat wheel transportion, and accordingly the industrial track system was abandoned and concrete aisles were laid on each side of the moulding floors. The trucks used for hauling moulds and sand were designed by the foundry company's own engineers. Mounted on this type of truck are one or two hoppers, on the bottom, or end, of which are teeth which engage holes in a rack below. A key which is fitted in a slot on the end of the hopper holds it in normal position. For dumping the key is removed and the hopper is rolled on its side. The moulds are lifted into the hoppers directly from the moulding floor, whereupon the cars are hauled by storage battery motor truck to a shake-out grate, where the contents of the hoppers are discharged. Likewise screened moulding sand is hauled by the hopper trucks through an aisle back of the moulding benches, where it is dumped in piles next to the benches.

When the cars are dumped on the shake-out grate the castings are removed and carried forward for sand blasting, tumbling, grinding, chipping, etc. The sand shaken out drops through a hopper to a continuous belt conveyor situated in the basement. The conveyor carries the sand forward to a magnetic separator, where metal impurities are removed and the sand is then discharged in a bucket elevator which carries it to a revolving screen. The screened sand drops into a hopper leading into another bucket elevator, which carries it up and deposits it on a conveyor, which throws it against a revivifier. The latter consists of a solid disc with studs projecting from the circumference and revolves at great speed. A water spray plays on the sand as it passes over the belt into the revivifier. After revivification the sand drops into a 30-ton hopper, under the discharge spout of which hopper trucks are moved to be loaded. The cycle of sand conditioning from shake-out grate to the 30-ton hopper is accomplished in three minutes.

A sand and fire clay storage was constructed adjacent to the section of the foundry addition containing the basement. This storage is placed near the railroad siding, so that sand and fire clay can be transferred directly from railway trucks to storage by locomotive crane, the material being dropped through hatchways in the roof of the storage. The storage has a capacity of 25 trucks of sand and five trucks of fire clay. From storage, sand is transferred to a motor-driven Simpson mixer, also in the basement. The method used in elevating the sand to the mixer is of interest. The sand is taken by wheelbarrow and dumped into a large scoop, the bottom of which is resting on the floor of the basement. The discharge end of the scoop is pivoted on a steel truss at a point just above the top of the mixer. For dumping, the bottom of the scoop is raised by cable, driven by the same motor which operates the sand mixer, until it reaches a point where the sand will pass by gravity into the mixer. After mixing, the sand is dropped through the bottom of the mixer into drop bottom buckets, which are carried by buggy to a point under an opening in the foundry floor, through which they are lifted by overhead travelling crane and distributed.

On the main floor of the addition to the foundry are found a George Whiting Company sprue cutter, one Whiting Corporation and two W. W. Sly Mfg. Company tumbling barrels, a number of grinding machines, including two radial grinders, an annealing oven, a sand blast, pneumatic tools for chipping, both electric and oxy-acetylene torches, and a weighing machine. The sand blast equipment was furnished by L. O. Koven and Brother, Jersey City, N.J. The annealing oven was constructed by the Hofmann Engineering Company, Chicago, and is fired by eight oil burners, four on each long side of the furnace. The oven is equipped with a Bristol Electric Company pyrometer, the annealing temperature ordinarily sought being from 870 to 895 deg. Cent. The automatic dial scale is of 2,000 lb. capacity and was manufactured by the American Krone Scale Company, New York.

The foundry is equipped with three 5-ton overhead electric travelling cranes. Two of these were manufactured by the Northern Engineering Works, Detroit, and the third by the Whiting Corporation, Harvey, Ill. A 12-kw. converter furnished direct current for the motors of the cranes, while a 10-kw. converter serves the magnet in the sand separator. Other power is secured from current furnished by three 150-kva. transformers, which step down the purchased current from 12,000 volts to 220 and 110 volts. Other features of the plant are an oil storage, situated adjacent to the railroad siding, and an acetylene generating room where gas for the oxy-acetylene torches is generated. The generating equipment was furnished by the Oxweld Acetylene Company, Newark, N.J.

A feature of the foundry addition is the dust collecting system. A dust tunnel has been laid under the floor, extending from the sand blast to the tumblers, thence to the grinding machines and then to the chipping room, leading finally to a dust arrester outside of the structure.

Frank D. Chase, Inc., Chicago, was the engineering firm in charge of the enlargement and remodelling of the plant. This company has also worked out plans for the future development of the property. In the event of expansion the present cleaning room will be given over to additional moulding area, leaving the sand conditioning apparatus centrally situated. The cleaning and dispatching departments will be moved into a new building to be placed at right angles to the present structure and in time additional moulding area will be provided there. The ultimate layout will utilise to the utmost all of the property available.

As it now stands, the plant of the Chicago Steel Foundry Company consists of a main foundry building 440 ft. in length and 159 ft. wide for about one-half that distance and 100 ft. wide for the remaining distance, and a building, 65 x 160 ft., containing pattern storage, machine and carpenter shops, etc.

Iron and Steel Institute.

Paris Meeting.

Supplementing the programme details issued in a preliminary circular in May last (see June 2 issue), a further circular has now been issued by the Secretary of the Iron and Steel Institute regarding the Autumn Meeting to be held in Paris on September 5 and 6 next.

An interesting programme of excursions to works and other places of interest has been arranged and divided into convenient groups. The works to be visited comprise the following: MM. F. de Wendel et Cie at Hayange and Jœuf; Compagnie des Forges et Aciéries de la Marine et d'Homécourt; iron ore mines of the Société des Mines de Jarny; Union of Consumers of Metallurgical and Industrial Products at Hagondange; Société Lorraine des Aciéries de Rombas; Société des Hauts-Fourneaux et Fondéries de Pont-à-Mousson; Schneider et Cie et Creusot; Société Normande de Métallurgie at Hèronville-Colombelles, near Caen; iron ore mines of the Société Normande at Soumont. Places of general interest include Metz, Nancy, Chalon-sur-Saône, Lyons, Saint Chamond, Trouville-Deauville, and Lisieux. Arrangements have also been made for members to visit the battlefields and cemeteries.

The Tin Box Trade Board give notice of a proposal to reduce the minimum wages of all adult workers by 1d. per hour, or 5s. per week.

The Egler Blow Torch for Open-Hearth Furnaces.

There seem to be two main elements in open-hearth practice, the improvement of which make for increased efficiency. These are furnace design and apparatus for combustion. Up to the present time there has been little radical change, in design at least, in stationary furnaces. This is necessarily a conservative, careful piece of work, for, as everybody knows, small changes bring great differences in results. Still, we must admit that the present furnaces are greatly improved in design over what was thought first-class work a dozen years ago.

In the combustion field, so far as it affects open hearth furnaces, progress has also been slow. The general plan seemed to be susceptible of but little change, no matter what fuel was used. Whether producer gas, liquid fuel, powdered coal or coke-oven gas, the arrangement for burning the fuel on the hearth has always been planned on the basis of natural or chimney draught. This has necessarily involved a theory of combustion which can readily be compared to the operation of the Bunsen burner.

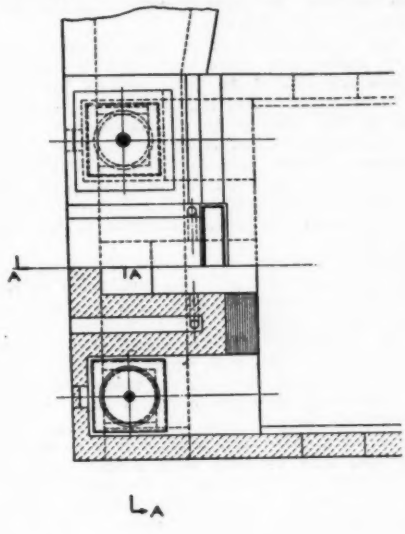
The air and gas are kept separate up to a point where ignition and combustion are to take place, the elements being proportioned so that there is a due excess of air in accordance with a formula, traditional and well-nigh sacred. So the area, length, diameter and materials of the fuel ports, uptakes, blocks, etc., have been carefully studied and great pains have been taken to see that these features, when once determined, are kept in their designed proportion and arrangement as nearly as possible.

It was Mr. Nicholas F. Egler who first saw the advantages of making the flame for the open-hearth furnace a blow torch rather than a Bunsen burner. After some considerable experimental work, he applied for his first patent on this subject in March, 1919. The Egler inventions and patents are in the hands of Messrs. Arthur G. McKee & Company, 11, Victoria Street, Westminster, for this country.

The first furnaces have been erected and installed at the Brier Hill Steel Company, at Youngstown, U.S.A., and are now operating there with marked success. In order to accomplish the results desired, according to the blow-pipe theory it is necessary that all the gas and air needed for combustion should pass through a port designed as a combined fuel and air port. This also requires in practice positive pressure on both air and gas.

In producer-fired furnace practice at Brier Hill, the air is put into the chequer chamber by fan pressure, the gas being fed to the gas regenerator at the natural producer pressure which happens to be just right. The gas comes up under the port hood at the end farthest from the hearth and is turned and directed downward towards it in the usual way. At the proper point in its flow towards the hearth the gas meets a stream of air fed vertically upward and across the stream of gas. The air flows all around the gas, below it as well as above it. The stratum of air below the gas is of peculiar advantage in practice. As soon as the gas and air meet, intense combustion immediately takes place. But such is the speed of the mingled gas and air (partly by pressure given to them but still more by the expansion due to combustion) that the temperature within the port itself is not found to be unduly high. The ends farthest from the hearth, which might have been expected to suffer by heat radiated into the pocket formed by the abrupt angle at the top of the uptake, have stood up perfectly so far and seem quite likely to last out the full campaign. The torch of air and gas rushes from the port nozzle in a perfectly mixed flame, and the air on the under side of the gas appears to make the flame duck down and hug the surface of the bath in a most satisfactory way. Combustion is entirely accomplished by the time the middle door of the furnace is passed, and the atmosphere of gas at the outgoing end of the hearth is quite clear.

The roof is bathed in a slow-moving body of air, the surplus over that needed for combustion. This air moves slowly because there is no great excess of air, and because it is unable to reach the roof except by detachment from the stream of flaming gas and by the expansion incident to the heat



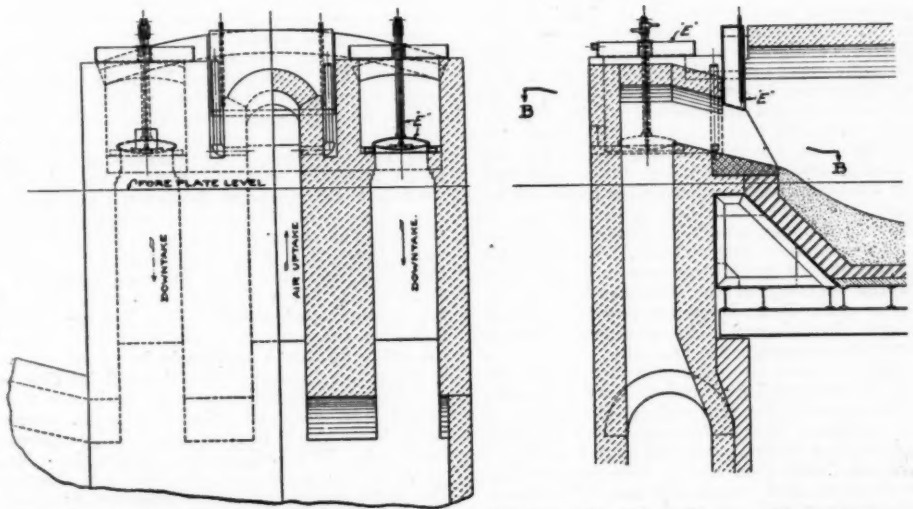


FIG. 1.—EGLER FURNACE USING COKE-OVEN GAS, NATURAL GAS, TAR, OIL, AND POWDERED COAL.

of the furnace itself. The roofs seem to be in as good condition as, if not better than, normal. The practice at Brier Hill seems to dispose of the theory heretofore held that excess air must be supplied in considerable volume to take care of the roof and walls. Until Egler's furnace was built nobody had ventured to eliminate this feature.

At each end of the furnace are two flues auxiliary to the main gas and air supply. These flues at the upper or furnace end of their uptakes are fitted with water-cooled mushroom valves on water-cooled seats. At the end where the gas is entering, these valves are tightly closed and the flues they cover (which are filled with air from the air regenerators) cannot discharge any air into the furnace. All must pass through the combined fuel and air port.

At the discharge end of the furnace these auxiliary valves are wide open and the valves themselves are drawn up into pockets provided in the furnace roof. The auxiliary flues thus uncovered permit the gases of combustion, now greatly expanded, to flow from the furnace to the regenerators. There are thus four outlet flues in use, two under the hood of the outlet port (one to gas chequers and one to air), and the two auxiliary flues, which are both connected to the air regenerators.

The furnace is, of course, reversed from time to time in the usual manner. The mushroom valves are simultaneously reversed also. No interruption or slackening of furnace heat is noticed on reversal. A noteworthy feature about these mushroom valves is the ease with which the valves and seats can be cleaned through an inspection door in the side wall directly opposite each valve. Observation of actual practice shows that the cleaning off of a valve seat takes only a couple of minutes, and may be done with a short-handled tool. The seats are customarily cleaned off once or twice a day, so the valves remain entirely tight.

Observations in the chequer chambers show that, while they are quite hot enough, they are in no wise overheated, notwithstanding the heat on the hearth. It may be stated that the hearth temperature is the highest ever systematically maintained. Observers agree that they have never seen anything like it. But the combustion is so perfect, and the heat transmitted to the bath so greatly in advance of previous practice, that the chequers stand at about 1,093 deg. Cent. all the time, inlet gas is about 815 deg. Cent., and the chimney temperatures run constantly from 370 to 425 deg. Cent. The waste-heat boiler is thus a superfluity. Chimney draft is necessarily low with such low chimney temperatures. These remarkable conditions of combustion are reflected not only in the economy of the furnace, but in its capacity as well. Records are too new to be given out as yet, but they will be available when a representative campaign has been run.

The Egler furnace is equally adapted to all kinds of gas or liquid fuel and to powdered coal. Other furnaces at Brier Hill will afford the opportunity to judge of the performance with natural gas and with coke-oven gas (with and without tar) and on liquid fuel alone. The installation for coke-oven gas and for natural gas differs from that above described on producer gas in the following particulars:—

There is only one set of regenerators; the air uptake is farthest from the hearth instead of nearest (as with producer gas); the gas admitted at a point betwen the air uptake and the port outlet to the furnace by the customary pipes, one on each side of the combined fuel and air port: and the supply pipe outlets are so located and directed as to ensure the most complete mixture of gas and air. Otherwise the furnace installations are the same; the mushroom valve arrangements are identical, and the whole theory of combustion is, as above described, strictly adhered to.

For liquid fuel the installation is similar to that for coke-oven gas. The oil or tar is admitted through the end wall beneath the hood of the port, which thus becomes a perfect retort, giving the liquid to the hearth in a state of complete gasification. The use of coke-oven gas in combustion with oil or tar is provided for in this manner by the most simple and easily-operated construction, equally efficient with either or both types of fuel.

For powdered coal the installation is also similar to that for coke-oven gas, except that the application of the coal fuel to the retort formed by the combined fuel and air port is dependent upon the type of powdered coal supply with which the steel plant may be provided. Where powdered coal is the indicated fuel, but has not been installed previous to the equipment with the Egler furnace, the arrangements for combustion are extremely simple. The retort is used also as a diffusion chamber, and especially constructed for that purpose.

It seems evident that a large increase in capacity and economy by the use of the Egler invention is assured, and also that open-hearth furnace construction costs are likely to be considerably reduced by its installation. It is already evident that brick materials can be used of cheaper grades than at present in several important parts of the furnace installation. This also is a subject which the future practice must confirm before positive statements can be made.

We are indebted to Messrs. Arthur G. McKee & Company for the above particulars, which have been gathered by Mr. G. L. Prentiss, of the Blair Engineering Company, who have the American rights

Russian Iron and Steel Production

Comparatively recent information concerning the iron and steel industry in the South of Russia is contained in the report of the Russian Central Administration of the Metallurgical Industry recently published by the Russian semi-official journal, "Economic Life."

The report states that the production of pig-iron in Southern Russia in 1920 amounted to 14,500 tons; that of open-hearth ingots to 46,000 tons; steel tubes, 3,100 tons; tyres, 850 tons; other iron and steel products, 40,300 tons. The great difference between the output of pig-iron and that of iron and steel products is attributed to the working up of stocks which still remained available. Pig-iron was only produced by two blast furnaces, the third (that of Yousofka) having only been started in December. The furnace at Makeevka was in operation as from September 5, and turned out 71 per cent. of the total production for the year. The furnace of the Russo-Belge Company was in service throughout the year, but only produced 3,300 tons, and it is said to be now used almost exclusively as a generator of gas! The Makeevka furnace continued working until January 6, this year, when it was stopped through lack of fuel. It was restarted on January 21, but work again had to be stopped at the beginning of March. The Yousofka furnace met with the same fate, and as from March last the only pig-iron being made has been produced by the single furnace of the Russo-Belge Company.

Open-hearth furnaces were at work to a limited extent and very irregularly at seven works in 1920, viz., those of the Russo-Belge Company, Lougansk, Donetz-Yousofka, Makeevka, Mariupol (Providence Russe), Sooline and Taganrog. The same works, with the addition of those of Chaudoir and Kramalorovka, produced the previously mentioned 40,300 tons of iron and steel products, comprising merchant bars, sheets and wire, while the Taganrog, Mariupol, Lougansk and Chaudoir works were responsible for the output of tubes.

DECREASE IN CANADIAN OUTPUT.—The Canadian production of pig iron and of steel ingots and castings during last January was the lowest on record since 1904. Of 20 blast furnaces only seven were in operation during the month, their production exclusive of ferro-alloys totalling 41,249 tons. Of this amount 28,326 tons were steelmaking iron and the balance of 12,923 tons merchant iron. The total production of spiegeleisen and ferroalloys during the month was 5,284 tons. The output of steel ingots and castings for January amounted to 40,058 tons of which 36,410 tons was made by the open-hearth process. Direct steel castings produced during the month totalled 3,127 tons. The greater part of this production was made by electric furnaces.

Estimated Melting Losses of Aluminium and its Alloys.*

By ROBERT J. ANDERSON.

Melting losses are a serious source of financial loss in brass and bronze practice, but they are especially serious in the case of aluminium and its light alloys because of the relatively high price of aluminium. The fact that the oxidation losses in melting aluminium and its light alloys are high is well known, but it is doubtful whether the factors governing the most suitable methods of melting for a minimum of dross are equally well known.

The essential requirements in the commercial melting of any metal or alloy are that the melting losses should be low and the melting should be rapid. Certainly it may not be possible to obtain these requirements in any furnace selected at random, and it follows that the design and the operation of furnaces for melting different metals are subjects that warrant the most extensive study and tests. As a general rule, in the industrial operation of furnaces run on aluminium and aluminium alloys, an effort is made to keep the dross and oxidation losses as low as possible. In attempting to hold dross losses low, numerous factors involved in metal melting may be overlooked, or at least disregarded, and the net practical result may be that the furnace is exceedingly wasteful of fuel. In the case of aluminium and its light alloys the effect of increasing the temperature of melting, at least in an atmosphere containing free oxygen and nitrogen, is to increase the net melting loss.

While there are a great many factors attaching to the operation of any metal melting furnace, the most important with regard to their bearing on dross losses in the melting of aluminium and its light alloys are probably the type of furnace employed; the melting temperature; the length of time required for melting and superheating to the pouring temperature; the length of time during which the metal is allowed to remain in the furnace after reaching the pouring temperature, that is, the "soaking" period; the constitution of the furnace atmosphere in contact with the metal, which is governed, of course, by the type of furnace, method of firing, and the fuel used; and the volume of air and products of combustion passing over the metal per unit of time. These and other factors governing furnace operation and dross losses as applied to the melting of aluminium and its light alloys deserve careful attention.

There are many factors also which influence the fuel consumption in melting, but it is sufficient here to point out only a few of the more important ones. These include the furnace design with relation to the combustion space; air supply; fuel used; relation of fuel supply to air supply; design of burner; and method for removing waste gases. On the whole, not a great deal of thought has been given to the design of furnaces especially intended for melting aluminium and its light alloys.

At the present time the selection of the correct type of furnace for a given set of operating conditions is made especially difficult by the multitude of different types of furnaces extant and more particularly by the lack of comparable data regarding each one. In general, the melting of aluminium alloys in foundry practice has followed along the general lines of brass melting, probably because these alloys have been cast largely in brass shops. Light aluminium alloys are, or have been, melted in all types of furnaces that have been used for brass and bronze. The iron pot furnace so widely used for the melting of so-called white metals is the only furnace employed for aluminium alloys that is not used for brass and bronze.

The type of furnace used depends upon whether aluminium or one of its light alloys is being melted, as well as whether, if aluminium, the metal is melted simply for re-pigging or for casting into rolling ingots, and if light alloys, whether they are to be poured into sand castings or used for the production of die or permanent-mould castings, or are poured into rolling ingots. The smelting of aluminium alloy borings and related aluminium bearing scraps presents a distinct problem, and various types of furnaces are used commercially for this purpose.

For melting the reduction cell metal, various types of furnaces have been used, but in the United States principally open-frame reverberatory-type furneces fired by gas, oil, or coal, appear to have been employed. For melting substantially pure aluminium prior to casting ingots for rolling or other working the reverberatory type furnaces are largely employed in the United States, England, Japan, and on the Continent. In the United States principally coal, but in more recent years gas and oil, have been used for the fuel in these furnaces. Still more recently rotating and tilting open-flame furnaces fired by gas and oil have found favour in some small rolling mills. The employment of the reverberatory type furnace in rolling mill work has been necessary because large capacity is desired and because continuous melting is desirable. Also a rectangular hearth type of granular resistor furnace has been used in the United States for aluminium melting.

It is light alloy foundry practice that the greatest variety of furnaces are found. The following types are in daily use in aluminium foundries of the U.S.: Gas and oil-fired reverberatory furnaces; gas and oil-fired stationary and tilting iron pot furnaces; coal and coke-fired, natural and forced-draught, pit furnaces; gas and oil-fired stationary and tilting crucible furnaces; gas and oil-fired stationary, rotating, and tilting open-flame furnaces; electric furnaces of different types. The stationary and tilting iron pot furnaces are favoured considerably, particularly by large foundries, but open-flame furnaces of different designs are being used more widely than a few years ago. In small foundries and in foundries where aluminium alloys form only a minor part of the output, pit or crucible furnaces are used largely. Electric furnaces for melting both aluminium and its light alloys are just now receiving considerable attention, and a few installations have been made. The tendency in recent years toward the use of furnaces of large capacity, as reverberatory, open-flame, barrel-shaped, and electric furnaces has come through the enlargement of plant capacity. Where a foundry is turning out 2,000 to 4,000 tons of finished castings per annum, melting in units of small capacity requires a large installation. One type of barrel-shaped open-flame furnace can melt at least one ton of metal per hour, and the advantage to be gained in operating units larger than stationary crucibles or iron pots are very apparent in foundries where the daily output runs up to thousands of pounds.

The average recovery from light alloy borings and related scraps is 65 to 70 per cent. The total amount of borings may be taken as 15 per cent. of the casting production; with the latter at the rate of 31,000 tons per annum, the total amount of borings available for melting is 5,400 tons. The average recovery from furnace dross containing 30 to 60 per cent. metallics may be placed at not more than 80 per cent. of the contained metal. With 40 per cent. metallics in the dross, and assuming that 2,000 tons of such dross is available for smelting, the total amount of available metal is 800 tons. The total amount of aluminium in various forms melted in the U.S.A. (1918 basis) may then be considered as at least 106,000 tons; if no account be taken of exports and imports. The exports are much less than the imports, and the latter are estimated as equal to about 10 per cent. of the domestic production. On this basis it can be estimated that at least 1,000,000 tons of aluminium in various forms is now melted in America.

All aluminium is melted at least twice and much of it several times, considering a given unit weight of metal. All primary metal from the reduction cell is remelted and cast either into pigs or into ingots for rolling or other working. All primary aluminium for the manufacture of alloys is remelted in the foundry or elsewhere when alloys are made. Some secondary aluminium is used in the constitution of charges for the production of rolling ingots, and a considerable amount of secondary aluminium alloy pig and light alloy foundry scrap is used in most foundry charges. It may be stated conservatively that the primary and secondary aluminium used is melted at least twice; there is a melting loss each time.

In distinguishing between aluminium melting practice and aluminium alloy melting practice, it is necessary to point out that about 50 per cent.

* From a report prepared for the United States Bureau of Mines.

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of the domestic consumption of aluminium is used as such, while the remainder is employed in making light aluminium alloys. Knowing the amount of aluminium and aluminium alloys melted and the average melting losses, it is possible to arrive at a figure for the annual monetary losses.

Metal Losses.

The actual loss of metal due to oxidation, that is, the so-called dross loss in melting aluminium and its light alloys, is large. It may be taken as not less than 2.0 per cent., although extreme figures of 0.75 and 5.0 per cent. have been reported. This refers to the melting of aluminium for casting into rolling ingots, and it may be taken as an average figure for aluminium on the basis of average rolling mill charges. The average net loss resulting on melting substantially pure aluminium may be taken as not less than 1.25 per cent., on the basis of reported figures, allowing for the recovery of mechanically entangled metal from the dross. If dross be considered to contain 40 per cent. metallic substance on the average, the net loss on this basis would be 1.20 per cent. (assuming perfect recovery). If it be considered that the metal is melted twice, then the average net loss of 1.25 per cent. is equivalent to 2.50 per cent. for all the aluminium used as such.

In the same way, the gross loss of metal resulting in melting for the production of alloys in foundry practice may be taken as 4.0 per cent. on the basis of figures reported to the Bureau of Mines, although extreme values of 1.0 and 8.0 per cent. have been given. This refers to melting in a variety of different types of furnaces. The average net loss in the melting of alloys in foundry practice may be taken as 2.5 per cent. on the basis of reported figures. If the dross be considered to contain 40 per cent. metallics on the average, the net loss on this basis would be 3.0 per cent.; this does not agree well with the figure given above. The figure 2.5 per cent. for the net loss will be used here. If it is considered that the metal is melted twice, then the average loss of 2.5 per cent. is equivalent to 5.0 per cent. on the gross melt.

In regard to the fuel losses in melting aluminium and its light alloys, it may be said that in general the fuel efficiencies obtained in average practice are extremely low. The fuel consumption is about twice that used in melting brass and related alloys, owing to the high specific heat and high latent heat of fusion of aluminium. Theoretically, if all of the available heat units in a fuel were utilised—that is, if the furnaces were operated at 100 per cent. efficiency—it would require the following approximate amounts of fuels to melt 100 lbs. of aluminium and superheat it to 800 deg. C. for pouring: 4.0 lbs. of coal or coke; 2.7 lbs. or 0.35 gall. of fuel oil; 57.0 cub. ft. of natural gas; 86.0 cub. ft. of town gas; and other fuels in proportionate amounts. However, in practice tremendous amounts of fuel in excess of the theoretical requirements are consumed. The actual limits of fuel consumption in melting light aluminium alloys in foundry practice, as reported to the Bureau of Mines, are as follows: 50 to 200 lbs. of coal or coke; 0.54 to 15 galls. of oil, and 150 to 1,000 cub. ft. of natural or artificial gas. It is doubtful whether the fuel efficiency in furnaces melting aluminium and aluminium alloys can be more than 5 per cent. of the theoretical efficiency on the average.

Turning now to the question of the monetary losses, figures have been derived for these values as applied to present commercial practice. In the consideration of net losses in melting, it was stated that the loss in melting aluminium is 1.25 per cent. and in melting aluminium alloys is 2.50 per cent. Since the melting is considered to be performed at least twice, then the net losses are 2.50 and 5.0 per cent. respectively, on the gross melt. On the basis that 50 per cent. of the aluminium consumed is used as such, and that 50 per cent. goes into the production of aluminium alloys, the following figures were obtained:—

Estimated Melting Losses of Aluminium and its Alloys.

	Tons.
Total consumption of primary aluminiums ..	1,000,000
Total aluminum used as such	50,000
Total aluminium used for alloys	50,000
Net loss in melting aluminium *b*	1,255
Net loss in melting aluminium alloys *c* ..	2,500
Total loss	3,755

a On the basis of the domestic production in 1918.
b Net loss, 2.5 per cent. on the gross melt.
c Net. loss, 5.0 per cent. on the gross melt.

Allowing for extra meltings, and on the basis of the above estimate (1918 basis) of 1,000,000 tons of total aluminium, melted as such or in the form of alloys, it may be stated conservatively that the net loss is about 4,000 tons of aluminium per annum, on the basis that all of the metallics of the dross and skimmings are recovered.

On the basis of a 1s. 4½d. metal market for primary aluminium, the total monetary loss may be considered to be £594,000 per annum. Setting aside any consideration of the additional losses in melting owing to furnace inefficiencies, overhead, and labour charges, it is evident that if the present net losses could be reduced 50 per cent. a saving of about £300,000 would accrue. Probably £400,000 yearly could be saved if the fuel and other losses were considered on the basis of similar improvements. However the calculations be made, it is certain that if the average practice were raised to the standard of the best practice, very great savings, at least of the order of those indicated above, would accrue to the aluminium industry. From a monetary standpoint, it is certain that the study of melting practice for aluminium equipment is a subject which warrants the most extensive study and tests. The statistics used above for the United States' consumption of aluminium are for 1918, which was a war year, when the consumption was the heaviest in history. Since that year a considerable slump has occurred and the present losses are not so large as those given. However, the order of magnitude is sufficiently accurate to convey the idea that the losses involved are serious and that every effort should be made to reduce them.

New Sand Cutting and Screening Machine.

The Whiting Corporation, Harvey, Ill., has recently developed a sand cutting and screening machine designed to aerate, screen, and temper moulding sand at one operation. It is now undergoing a series of foundry tests before being placed on the market.

A series of rapidly revolving blades throw the sand toward the centre of the machine, where it is gathered by the bucket elevator and conveyed

A NEW SAND-CUTTING MACHINE.

to the revolving screen. The screen mixes the sand and removes refuse, such as gaggers, wedges, runouts, broken cores, etc. The clean sand is deposited in a windrow beneath the machine ready for moulder's use.

Among the features may be mentioned: Two cutting speeds selectively engaged by a jaw clutch, a steering mechanism that permits turning in narrow quarters, and electric-motor or gas-engine operation of all movements.

A NEW DEOXIDISER.—A patent for an alloy claimed to be suitable for deoxidising iron and steel, has been granted to F. M. Becket, by the American Patent Office, and bears the number 1,322,158. The alloy has the following composition:—Magnesium, 50 to 70; silicon, 10 to 20; manganese, 10 to 20; and iron, 10 per cent. or less.

The Triple Process of Manufacturing Malleable Cast Iron.*

By H. A. Schwartz.

Practically the only radical change in melting practice which has been introduced into the malleable industry in the last half century is the use of electric furnaces. So far only one producer operates under this method, which is protected by a number of patents covering the conditions necessary to commercial success.

In electric operation, increased accuracy of chemical control is made possible and the success of the melting operation is independent of variations in quality of stock and fuel and of blast and similar conditions. The belief that electric melting is adopted because it permits the manufacture of alloys of compositions unattainable in the air furnace is not founded on fact. While it is possible, for example, to make iron as low as .017 per cent. in sulphur, if desired, there is no engineering advantage in such an operation.

Electric melting as practised to day is conducted by the triplex process, developed by W. G. Kranz. This process supplements the advantages of the electric furnace with the use of a cupola and a Bessemer converter to assist the electric furnace in operations to which it is not so well suited. The rationale of the process is as follows:—

The electric furnace alone is suitable for melting or heating metal with slight contact with air or any other substance except the furnace lining and slag. Therefore, it is suited rather to keep the composition of its contents unaltered than to make changes in composition.

Chemical changes occur therein only as a consequence of the addition of various alloys or slag-making ingredients, and the effect of such additions can be quantitatively controlled. The changes of chemical composition easiest of attainment in the electric furnace are increases in silicon, manganese, or phosphorus and decreases in sulphur and oxygen. Carbon can be added or removed, or silicon removed with greater difficulty, but the removal of phosphorus is not practicable under the usual operating conditions in malleable melting.

Whereas the electric furnace is an expensive source of heat energy, the cupola is the cheapest known method for merely melting cast iron where composition is of no importance. Cupola melting always removes at least part of the silicon and manganese and adds sulphur, leaving the phosphorus unaltered. The carbon content is nearly independent of the mix used, depending only on the condition of the fuel bed. The carbon content always is relatively high.

The Bessemer converter furnishes an easy and economical way to remove all carbon silicon and manganese from iron, but adds a great deal of oxygen.

The three units form an ideal team, each possessing good qualities to supplement the weak points of its mates. The cupola furnishes cheaply a supply of liquid iron of high and approximately constant carbon content which readily can be controlled as to its maximum silicon, manganese, and phosphorus content, but may have high sulphur from the fuel. Carbon, silicon and manganese can be removed from this metal in the Bessemer converter, though oxygen may be added. By taking the proper relative amounts of cupola and Bessemer metal a mixture can be produced having a carbon content close to any desired value, and which also is below any desired fixed values in silicon, manganese, and phosphorus. However, it contains an indefinite and relatively large amount of sulphur and oxygen.

This molten mixture can be given its final heating in the electric furnace without too great expense, and by the use of suitable slags the sulphur and oxygen can be removed without any effect on the silicon, manganese, or phosphorus. Guided by the analysis of the molten charge, silicon and manganese can be added to adjust these values as desired and a product made without prohibitive cost, adjusted to chemical specifications on each of the five common elements and freed from oxygen.

*Extracted from the "Iron Trade Review."

These are the steps in the Kranz process, which since passing through the experimental stage in 1913-1914 has produced many thousands of tons of malleable cast iron in two plants of the largest producer of malleable in the country. The process as outlined comprises melting in the cupola; decarburising in the converter; heating, desulphurising and deoxidising and raising the manganese and silicon in the electric furnace; and, if desired, adding sulphur in the ladle. For still greater uniformity it was once suggested that the cupola and converter metal be placed in a mixer prior to its introduction into the electric furnace, but practice has proved that this step is not necessary.

It has been found that a product varying from dead soft steel to grey iron, and including alloy steels can be made by this process at the will of the operator. If dephosphorisation is desired, for example in steel-making, an extra step is required in the electric furnace, involving the formation of a dephosphorising slag and its removal before proceeding with the desulphurising and deoxidising.

Metallurgy of Triplex Process.

It may be well to consider the individual steps involved in greater metallurgical detail. In general, the melting stock consists of sprue and malleable scrap and high silicon pig-iron. The mix is calculated only to be close to the desired value in silicon content. The manganese automatically remains low and with a little care the phosphorus can be kept below about 0.19 per cent., which is all that is required.

It is intended that the cupola metal shall run slightly under 1 per cent. silicon. Too low a value causes trouble from making up the cupola taphole and spout and the ladle. The maximum is determined by the metal to be made. The composition of the metal leaving the cupola under ordinary working conditions is approximately as follows: Carbon, 3.10; silicon, 0.80 to 0.95; manganese, 0.12 to 0.19; sulphur, 0.09 and up, and phosphorus, 0.14 to 0.19 per cent. The dimensions of the cupola are such as to allow the unit to run continuously to produce the metal required by the electric furnaces. Interruptions and intermissions are undesirable because they affect the temperature of the fuel bed and consequently the carbon content.

Two cupolas are provided and are used alternately to permit repairs.

The converter easily reduces the molten metal to a composition about as follows: Carbon, 0.20 and under; silicon, trace; manganese, trace; sulphur, 0.12 and up; and phosphorus, 0.17 per cent. A considerable oxidation of iron also occurs, which together with the mechanical loss in the form of fine drops amounts to from 8 to 15 per cent. of the converter charge. If a carbon content of say 2.60 per cent is desired, cupola and converter metal in the ratio of 240 to 50 will be required, and the mixture will have a composition as follows: Carbon, 2.60; silicon, 0.66 to 0.78; manganese, 0.10 to 0.16; sulphur .095 and up; and phosphorus 0.14 to 0.19 per cent.

Since each furnace heat is handled as a unit, it will be seen that the converter charge is dependent on the capacity of the electric furnace and the carbon content of the cupola metal. In the illustration chosen the converter must deliver 50/290 or about 17 per cent. of the capacity of the electric for each blow. The metal introduced must exceed this amount by the expected oxidation and mechanical losses.

The electric furnaces actually in use have a rated capacity of six and 15 tons respectively, so that when working at full capacity the converter would have to deliver 1.02 and 2.35 tons respectively.

The electric furnaces used are of the Heroult type, operating on 3-phase, alternating current. The 6-ton units consume 800 kilovolt-amperes of power at 80 to 100 volts and the 15-ton units from

XUM

18,000 to 22,000 kilovolt-amperes at from 90 to 110 volts.

The Working of the Furnace.

The internal diameter of the larger units is approximately 10 feet. In all cases the bottoms are dolomite and the lining of the side walls magnesite. The molten metal is introduced into the furnace, the arc formed, and a lime slag made on the surface. The slag-making ingredients are lime, fluorspar and coke; in amounts determined by the working conditions and not by weight. About 150 pounds of lime and coke and 100 pounds of fluorspar may be used in a 12-ton heat, the active ingredient of the resulting slag being calcium carbide, CaC_2. This carbide reacts energetically with any metalic oxides present. For instance.

$$3\ FeO + CaC_2 = CaO + 3\ Fe + 2\ CO.$$

No appreciable amount of CaC_2 are formed until the oxygen is practically completely eliminated. At that stage the elimination of sulphur begins, the products being CaS and carbon, which dissolves in the metal. This process cannot be conducted under any but a reducing condition for CaS is easily oxidised to CaO, but sulphur unfortunately not burning to SO_2 but dissolving in the iron. This introduces certain difficulties in lowering the silicon content. For example silicon is easily and almost quantitatively oxidised by ore, the reaction presumably being

$$Si + 2\ Fe_2O_3 = SiO_2 + 4\ FeO.$$

Unfortunately the FeO of the resulting slag immediately reacts as follows:—

$$FeO + CaS = FeS + CaO,$$

and the desulphurising must be recommenced. The removal of silicon can be conducted in this way, but it is a cause of considerable difficulty in the maintenance of the desired slag.

Fortunately the high carbon alloys occurring in malleable practice do not take up carbon from the carbide slags used to any appreciable extent, nor does the CaC_2 reduce a considerable amount of silicon from any calcium silicates which may be present.

A sample is taken for analysis after the metal is thoroughly mixed in the furnace and should show a correct amount of carbon and phosphorus, and a deficiency in silicon and manganese. These latter two elements are added as ferrosilicon, ferromanganese, spiegel or similar alloys. Carbon can be added as pig, cupola iron, or in very hot heats as coke, or can be reduced by steel additions. Silicon can be removed with ore as previously described but it is not intended that this be done in regular practice. The removal of phosphorus from malleable heats is so expensive that it is cheaper to scrap such heats than to attempt to correct them.

Limit of Temperature.

The temperature to which electric metal can be heated depends only on the refractories used and in commercial practice is from 1,425 to 1,650 deg. Cent. It is customary to take a heat away in one or two large ladles and to proceed immediately with another heat. The advantages of the process already have been pointed out and all point back to accuracy of control. The most serious limitation is the expensive first cost of the melting installation, which places it beyond the reach of the small producer. Furthermore the process is not suited to intermittent operation involving the banking of cupolas and filling of electric furnaces with coke. To obtain successful results a 24-hour day during the working week is necessary. Counting 1½ hours per heat or 16 heats per day and allowing for some loss of time for repairs between heats, and bearing in mind possible reductions in economy where very small units are used, a simple calculation will indicate that successful operation can be had only in plants of fair capacity.

The two plants now in operation are equipped with three small and two large furnaces, respectively, and are intended to operate on large tonnages. Furthermore, the crane service required for the handling of hot metal, etc., almost precludes the introduction of hot melting into any but an especially built plant, thus further limiting its general introduction

All this is in addition to the limitations to the general use of the process due to its control through patent protection. Furnace repairs are relatively much less frequent in electric furnaces than in air furnaces. The bottom is taken care of after each heat. The magnesia side walls and silica roof each last from 120 to 240 heats, while the basic bottom, being repaired after each heat, lasts indefinitely.

The cost of heat in the electric furnace is high, but on the other hand the utilisation of heat reaches an extremely high efficiency owing to the elimination of the losses in fuel-fired furnaces arising from the escape of the hot products of combustion. The current is on about one hour for each heat.

Wear of Linings.—Charging, tapping and patching consume up to 45 minutes of time. Cupolas are intended to run a week on each lining.

The converters are of the side-blown type of a capacity suited to the Heroult furnace they serve and are lined with ganister. Converter bottoms last about a week, and the tops nearly indefinitely.

Cupola Conditions.

It will be instructive to follow quantitatively the chemical changes occurring. The following analysis is typical of the slag produced by the cupola:

	Per cent.
SiO_2	52.90
Al_2O_3	12.80
FeO	5.10
Fe_2O_3	.00
MnO	2.60
CaO	21.30
MgO	3.70
S	0.20
Not determined	1.40
	100.00

This is practically a mixture of molten refractory and limestone, little oxidation of the metal having occurred under the strongly reducing conditions of the cupola.

Assuming that the cupola charge consists of 10 per cent. silicon pig, sprue and malleable scrap, the two latter averaging 0.70 silicon, in order to have a mixture at 1.10 silicon the mix will contain 4.3 per cent. pig iron and, for example, 40 per cent. sprue and 55.7 per cent. malleable scrap. The average analysis of such a mixture works out as follows: Carbon, 2.68; silicon, 1.10; manganese, 0.27; sulphur, 0.055; and phosphorus, 0.177 per cent. This metal, when melted and leaving the cupola, has a composition of carbon, 3.10; silicon, 0.85; manganese, 0.15; sulphur, 0.09; and phosphorus, 0.177 per cent. This change of composition coupled with the previously given slag analysis amounts to a net loss by oxidation of 0.166 per cent. of the total weight charged.

The oxidation of silicon, manganese and iron is nearly balanced by the gain in sulphur and carbon from the fuel. In practice there is a loss of noticeable magnitude due to mechanical causes. By calculation the slag corresponds to 5.8 per cent. of the weight of the charge; 16.84 per cent. is derived from oxidation of the metal; 25 per cent. from the limestone added as a flux; and the balance from the fusion of the furnace lining, coke ash, impurities in stone, etc., assuming the limestone to have been 90 per cent. $CaCO_3$, the weight of the limestone added was about 50 per cent. of the slag weight of 2.9 per cent. of the weight of metal charged. The limestone lost to the flue gas an amount of CO_2 equal to 11 per cent. of the slag weight.

Converter Conditions.

When the cupola metal is blown in the converter it becomes a steel containing, for example: Carbon, 0.10; sulphur, .095; and phosphorus, 0.187 per cent. The slag formed has a composition of which the following is typical:

	Per cent.
SiO_2	57.50
Al_2O_3	1.43
FeO	34.41
Fe_2O_3	1.45
MnO	3.80
CaO	0.25
MgO	0.34
Not determined	0.82
	100.00

A loss in weight of 5.36 per cent. of the weight charged into the converter is indicated. In practice a larger loss is noted due to mechanical losses and to considerable amounts of iron oxide which escape as fume and are not taken into account in the analysis.

The slag is equivalent in weight to 4.86 per cent. of the metal charged. Of this slag 50.08 per cent. is an oxidation product of the metal and 49.92 per cent. is fused refractory.

Electric Furnace Conditions.

In the electric furnace no oxidation takes place, the only elements affected being sulphur and oxygen which leave the metal to become calcium sulphide and carbon monoxide, respectively. The former remains in the slag, while the latter escapes as a gas. Therefore the slag in the electric furnace is not in any material degree derived from the elements in the iron, but depends for its quantity and largely for its composition on the slag forming additions used. These are lime (CaO) fluorspar (CaF_2) and coke. The supposition is that the coke and lime from calcium carbide which removes both sulphur and carbon.

However the slags never are nearly pure mixtures of CaC_2 and CaF_2. The typical slag obtained under conditions which would possibly have destroyed any CaC_2 by the action of the atmospheric moisture had a composition as follows:

	Per cent.
SiO_2	29.80
Al_2O_3	2.85
FeO	0.50
Fe_2O_3	nil
MnO	0.18
CaF	0.70
CaO	44.51
MgO	7.55
CaS	7.20
Not determined	6.71
	100.00

From the behaviour of the slag it seems reasonable that most of the lime is combined with silica and that there is but little free CaO as Ca (OH)$_2$ either normally present or derived from the decomposition of carbides. Possibly the CaO from these sources may run to 5 per cent. or similar undetermined amounts.

Possibly the MnO shown is MnS floating up from the metal. The fluorine apparently is largely eliminated in the furnace. Data as to slag quantities are uninteresting as having no connection with the metallurgical principles. The additions may amount in the aggregate to perhaps 1 or 1.5 per cent. of the weight of the metal.

Metallurgy of the Slag.

Assuming a desulphurisation of .07 per cent., the slag composition referred to and excluding the sulphur from the coke amounts to around 44 pounds of slag per ton of metal. Of the slag the SiO_2 Al_2O_3 and MgO are primarily derived from the furnace lining. Those comprise 40.2 per cent. of the entire slag. Therefore for each ton of metal 17.6 pounds of refractory are melted and 26.4 pounds of slag is formed from lime, fluorspar and carbon and from the metal itself. Of the ingredients from the metals the principal item in weight is 1.4 pounds of sulphur, the MnO and FeO being only about 0.3 pounds per ton. Deducting these two, the slag has 24.7 pounds of material per ton of metal derived from the slag-forming additions.

All of these figures mentioned are to be considered as suggestive only. A balance sheet of the elements concerned in the triplex process is shown in Table I. It must be understood, however, that the process has not been quantitatively investigated to the point where all the reactions are clearly worked out. The figures in the balance sheet for oxygen are merely estimates. The sulphur data are not based on a complete series of tests, but are in accord with current practice. The table neglects oxygen in original metal and final product. Ferromanganese and ferrosilicon are not supposed to be added. If charged into the electric furnace these alloy quantitatively with the charge.

Heat Balance of Triplex Process.

A heat balance for the triplex process is extremely interesting as giving an insight into the character of heat losses remaining. Unfortunately the results of complete tests of the process including all the factors involved are not available. Also the heat of formation of some of the compounds entering into the reaction, more particularly in the electric furnace are not known. In the absence of this information the following balance has been built up on estimates from other sources of the composition of gas leaving the cupola and converter, and of the temperature of the cupola gas, and of the metal at various stages. Also the heat of formation of the slag has not been considered a source of energy nor has allowance been made for the latent heat of fusion of slags and refractories.

The presence of oxygen in the metal, at various stages has not been followed quantitatively so that no account of the thermal effect of the formation and reduction of FeO can be taken. The latter items are included among the undetermined losses at the various stages of the process. However, the balance in Table II, based on one ton of metal charged into the cupola and on temperatures above room atmospheric may be regarded as indicative of the major items.

TABLE I.—*The Balance Sheet of Distribution of Metalloids in Electric Furnace Practice.*

In pounds per ton of cupola charge.

	In cupola charge.	From cupola charge.	Furnace converter air.	Total.	In final product.	In cupola slag.	In converter slag.	In converter gas.	In electric furnace slag.	To electric furnace atmosphere.
C	53.6	8.3	...	61.9	51.90	...	...	10.0	...*	...
Si	22.0	...	...	22.0	14.17	5.0	2.83	...	...*	...
Mn	5.4	...	...	5.4	2.46	2.4	0.50	...	0.04	...
P	3.54	...	...	3.54	3.54	...	...	...	...*	...
S	1.10	0.7	...	1.80	0.8	...	...	...	1.00*	...
O	...	...	0.60*	0.60	...	...*	...*	...*	...	0.6
Fe	1914.36	...	...	1914.36	1904.84	4.8	4.60	...	0.12*	...

* Includes only those amounts at some stage alloyed with the molten metal.

TABLE II.—*The General Heat Balance of Triplex Process*

	B.t.u.	B.t.u.
CUPOLA.		
Heat value, fuel	3,718,000	
Total heat, metal		1,692,000
Sensible heat, slag		63,800
Sensible heat, flue gas		180,000
Heat value of Fe, CO in flue gas		744,000
Radiation and unaccounted for		1,038,200
Total output		3,718,000
CONVERTER.		
Total heat of metal charged	282,000	
Heat of combustion of C, Si, Mn.	93,400	
Total input	375,400	
Total heat, metal		292,800
Sensible heat, slag		10,900
Sensible heat, gas and undetermined		71,700
		375,400
ELECTRIC FURNACE.		
Total heat metal charged	1,690,800	
Heat equivalent of electric input	564,200	
Total input	2,255,000	
Total heat, metal		1,865,000
Sensible heat, slag		23,000
Radiation and undetermined		367,000
Total output		2,255,000

The cupola utilises 45.5 per cent. of the heat of the fuel, the converter delivers 77.7 per cent. of the total heat supplied, using 11.5 per cent. of the heat of combustion of the elements burned in further heating the metal. The ladle loss in transferring the metal, not shown above, amounts to less than 1 per cent. The electric furnace delivers in the metal 82.7 per cent. of all the heat furnished it, using 30.9 per cent. of the thermal equivalent of the electric input in heating the metal.

A summary of the heat balance based on the process as a whole appears in Table III.

Table III.—*The Heat Balance of Units in Triplex Process.*

	B.t.u.	B.t.u.
Heat value of coke	3,718,000	
Heat value of current	564,200	
Heat combination of Fe, Si, Mn and C	93,400	
Total heat input	4,375,600	
Incomplete combustion in cupola		744,000
Sensible heat, slag, ...		63,800
Sensible heat, flue gas		180,000
Radiation and undetermined		1,038,200
Total cupola loss		2,026,000
Sensible heat, converter slag		10,900
Sensible heat, gas and undetermined		71,700
Total converter loss		82,600
Ladle loss by radiation (pre-heated ladle) ..		12,000
Sensible heat, slag		23,000
Radiation and undetermined		367,000
		390,000
Total heat, metal		1,865,000
Total output		4,375,600

The tabulation may be condensed somewhat further and expressed in percentages of the total heat supplied by fuel and power as follows:

	Per cent.	
Heat of combustion fuel	86.5	—
Heat equivalent of power..	13.5	—
Heat of combustion of elements in converter	2.2	—
Heat loss in cupola	—	47.3
Heat loss in converter	—	1.9
Heat loss in ladle	—	0.3
Heat loss in electric furnace	—	9.1
Total heat metal	—	43.6
Totals	102.2	102 2

The figures show the relatively very great thermal efficiency of the process as compared with air furnace or open-hearth melting. A heat made from cold stock in the electric furnace would show a still higher thermal efficiency, approximating that of the electric furnace alone. This would not, however, correspond to a greater economic efficiency in view of the greater cost of a heat unit as electric energy than as coke.

From the standpoint of fuel consumption a consideration of the electric furnace is not complete without pointing out that a consumption of 2½ pounds coal per kilowatt-hour is an extremely economical figure, attainable only in unusually large turbine-driven plants. There would be superimposed on this further transformer and line losses so that the electric furnace may get from 4 per cent. to 8 per cent. of the energy of the boiler fuel as electric energy.

This consideration coupled with the high overhead for the power plants accounts for the great cost of heat energy derived from electric power as compared with an equal amount of heat energy potentially present in the fuel.

The South Wales Basic Slag Company, Limited, have started a new industry at Panteg, near Pontypool, where the basic slag will be mixed and crushed with phosphate, but proportion of the seaborne trade will at present go to Cardiff, Swansea, and Port Talbot.

The railway statistics for May, which are now available at the Stationery Office, reveal the effects of the coal stoppage. The total tonnage conveyed showed a decline of 21¼ million tons(or 75 per cent., compared with May, 1920, and the ton-miles worked a decrease of 70 per cent.

Effects of Scratches in Materials.*

By Professor Ernest G. Coker, M.A., D.Sc.

The importance of having a smooth surface in metals exposed to a high stress has been recognised by many engineers who impart a high degree of finish to their work, especially in cases where an intense stress varies cyclically, as in the moving parts of high-speed machinery. The increased strength and extension due to a high degree of polish in a tension test-piece has also been frequently noted, and the elimination of scratches appears to be of importance in many other cases.

The effect of a surface scratch in a stressed material is therefore a problem of great interest and in general of considerable complexity. It is probable that little is lost by making as simple assumptions as possible in examining this problem, and in the great majority of practical cases it seems likely that the scratches produced by ordinary machining operations may be considered as minute notches in the surface, probably with plane or curved sides inclined at a considerable angle and rounded off at the bottom of the notch by curves with radii much greater than the average size of the unit of crystalline structure of the metal. For ease of experimental investigation the effect of a scratch or group of scratches may be studied with advantage in a transparent body. If, for example, a scratch is made in the edge of such a plate under tension or bending stress, the stress concentration produced can be observed, and if the mean tension is, say, one-third or even less than that of the yield point of the material, it is usual to observe signs of overstress at the scratch; while, if the load is alternating, these indications gradually penetrate farther and farther into the material, apparently along planes inclined at 45 deg. to the line of pull in ductile bodies, that is, along the planes of maximum shear stress.

In a group of scratches sufficiently close to affect one another, the combined result is, naturally, still more noticeable, and the failure of a material under a comparatively moderate mean stress, due to surface scratches, is not difficult to understand, especially if the loading is of an alternating kind.

The form of the scratch produced is all important, and a comparative estimate of various types can be easily obtained without the complication of microscopic examination by examining notches on the large scale under conditions in which the influence of boundaries, other than those of the notches themselves, are practically unimportant. If this is done it can be shown, for example, that a scratch producing a semi-circular groove† in the material may raise the stress to about double the average stress, while a groove with straight sides at 45 deg. and a radius at the apex of one-eighth of the depth gives an increase of rather less than five times the mean stress, according to the recent measurements of one of the author's research students, Dr. Paul Heymans.

Increased sharpness of curvature at the bottom of the notch produces still greater local stress, and this latter may easily cause a fine crack to develop and produce failure owing to its rapid extension into the material caused by the abnormal concentration of stress at the extremities far transcending the ability of the material to bear, even if it approached the tenacity which it seems possible it might have from calculations of intrinsic pressure and, in the absence of cracks, flaws and cavities.

The Lincoln foundry trips opened on July 23, but owing to the general depression in trade, there was an extraordinary falling off in the number of excursionists.

The schedule of exhibits for the Birmingham Section of the British Industries Fair of 1922 (to be held from February 27 to March 10) has been considerably widened, and new groups are included, and in addition, several existing trade groups have been enlarged, and are now thoroughly comprehensive of the manufactures embraced by the respective titles.

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* Read before the recent Engineering Conference of the Institution of Civil Engineers.

† E. G. Coker, "Photo-Elastic Measurements of the Stress Distribution in Tension Members used in the Testing of Materials." *Min. Proc. Inst. C.E.* 1921.

The Chemistry of Combustion.*

By E. V. EVANS, O.B.E., F.I.C.

The use of raw coal for the generation of heat can be appealed against for two specific reasons—viz: (1) The highly complex nature of the reactions, both physical and chemical, which take place during the combustion of raw coal, and the consequent difficulty of controlling its combustion in an adequate manner and obtaining at the same time the maximum conversion of energy. (2) The loss of raw material required for the promotion of the chemical industries which results from the combustion of raw coal.

The combustion of carbon is commonly represented as a simple bimolecular reaction:

$$C + O_2 \rightleftharpoons CO_2$$

reversible only at very high temperatures.

Further it is well known that carbon dioxide will react with incandescent carbon to produce carbon monoxide:

$$CO_2 + C \rightleftharpoons 2CO$$

which is again a reversible reaction.

The belief is very widely held that, when a limited volume of air is passed through a bed of incandescent carbon, these two reactions represent the mechanism of the production of carbon monoxide. A large amount of research work has been carried out to determine the chemical equilibria of these reactions; but as the combustion of carbon is of a more complicated nature than is represented by these equations, the information so far obtained has been of limited value to the designer of gas-producers.

It is now generally accepted that the primary product of the oxidation of carbon is a complex of carbon and oxygen which has a transitory existence. This complex decomposes into a mixture of carbon monoxide and carbon dioxide in proportions which depend upon the temperatures at which decomposition takes place. The fundamental point of this hypothesis, which is confirmed by research, is that some carbon monoxide is formed directly without the intervention of carbon dioxide, and that a third reaction has to be added to the two so-called producer-gas reactions. It will be realised that in producer-gas generators this directly obtained carbon monoxide produced in the lowest layers of the fuel bed is surrounded by oxygen molecules which have not yet succeeded in reaching the carbon surface, and is therefore liable to rapid oxidation to carbon dioxide before it travels very far on its passage through the fuel bed. If the fuel bed be more than a few inches deep, and at a sufficiently high temperature, this carbon dioxide will be again partially converted to carbon monoxide according to the second of the reactions stated above. The product will then be found as a constituent of the producer gas, or will burn with its characteristic flame according to the conditions of air supply to the fire.

The combustion of hydrogen is a trimolecular reaction:

$$2H_2 + O_2 \rightleftharpoons 2H_2O$$

which is reversible at very high temperatures; and although intermediate stages in the oxidation process have been studied, the reaction is a simple one which calls fo no special mention.

The combustion of the simpler gaseous hydrocarbons introduces reactions which are more complex than those hitherto mentioned. Although combination with oxygen at high temperatures appears to take place in a simpler manner it is not really the case. It has been shown that, when combustion proceeds at low temperatures in the presence of a catalyst, many intermediate products are formed before the final products, carbon dioxide and water vapour, emerge. Thus during the slow combustion at 400 deg. C. of the simple hydrocarbon ethane, products such as ethyl alcohol, glycol, acetaldehyde, formaldehyde, and formic acid are formed before the final production of carbon dioxide and water vapour. Oxygen enters the molecule at several definite stages, involving the successive formation of the products mentioned above. Therefore the apparent simplicity of the reactions involved in the combustion of simple gaseous hydrocarbons is due to the high velocity of the reaction at high temperatures.

Now the combustion of the more complex hydrocarbon molecules has not yet been studied in the manner described above; but it is easy to imagine that, as the hydrocarbon molecules increase in their complexity, so the number and variety of intermediate stages in the oxidation process also increase; and that a culminating point will be reached when the formation of intermediate products cannot be masked by the high velocity of the reaction. The result is a tendency to incomplete combustion.

In the case of the combustion of raw coal, the complexity of the reactions which take place during oxidation is augmented by a number of side reactions of a physical as well as of a chemical nature; The process is preceded and accompanied by the decomposition of the coal substance. Long before the ignition temperature of coal is reached —which for the purpose of the discussion may be regarded as the temperature at which active oxidation occurs—some of the coal substance melts or decomposes into less complex bodies, and frequently with the evolution of gas, while the newly-formed degradation products may also melt and further decompose. If the boiling point of any of these liquids is lower than the temperature of decomposition, distillation will immediately take place; and if the vapours come into contact with a cooler zone, condensation and smoke formation will result. The gas may, however, become heated in the course of its passage, so that ignition takes place; but it is impossible to predict the sequence of events, as it is impossible to control the conditions to which the products of combustion will be subjected. There is no doubt that the coal substance undergoes extensive decomposition, either in the solid or liquid form, prior to distillation. Whether the distillation products ignite or escape as smoke would appear to depend upon the relation between the ignition temperature and the boiling point. Where there is a large temperature difference there is obviously greater opportunity for the gas to be carried away into a cooler zone before combustion occurs.

Another factor to be considered in connection with the combustion of smoke is the fact that it is usually evolved in a zone already highly charged with products of combustion from the fire below. For this reason, a suitable excess of air must be provided; and if any such air is admitted to the combustion chamber above the level of the fire. it must be preheated to avoid cooling the smoke below the ignition temperature.

The use of raw coal is deprecated owing to the impossibility of controlling the combustion process, This results in either the production of smoke or the use of a large excess of air, both of which represent loss of energy. This does not apply to the use of such bodies as oil fuel or powdered coal, the combustion of which may be controlled in the same way as that of gaseous fuel, though perhaps not to the same extent.

Finally, the combustion of raw coal represents to the chemist an appalling waste of inorganic and organic chemical products, such as ammonia, sulphur, cyanogen, and coal-tar derivatives; the latter being those products on which we mainly depend in building-up an organic chemical industry which may in future successfully compete against that of Germany.

* From a paper read before the summer meeting of the Institute of Mechanical Engineers.

AMERICAN STANDARD CONTRACT FOR PIG IRON.—The American National Association of purchasing Agents is seeking the adoption of a standard contract for the purchase of pig-iron. A tentative draft has been prepared by the Association and issued to its members for the purpose of bringing forth suggestions and criticisms before final action is taken. The proposed contract states the quantity and grade of the pig iron sold and shipped to the buyer, the price per ton of 2,240 lbs., the point of delivery, rate of shipment, etc., and an analysis of the iron, showing percentages of silicon. phosphorus, sulphur, and manganese. Terms of payment, weights and contingencies under which either party may be excused are plainly stated on the contract. The whole seems to comprise a plain and comprehensive contract under which both buyer and seller knows exactly his position in regard to the other.

XUM

Squares and Straightedges.

By J. Drinkwater.

Iron tools have gradually displaced wooden tools in the pattern-shop. Most craftsman have long ago substituted iron planes for wooden planes and iron squares for wooden squares. Broadly speaking, if iron tools are in condition greater accuracy is possible than with wood tools, and as in every engineering workshop, accuracy becomes more important all the time in the pattern-shop. But whilst iron adjustable squares are extremely useful yet for much work that is done large wood squares have still to be used; and, generally speaking, iron straight-edges are not popular with pattern-makers. One reason why iron straight-edges are not more used is probably because of their weight, pattern-makers having to carry their own tools about with them; but the chief reason is, perhaps, because the wood straight-edges are what is termed "kindlier," although it is not easy to explain what the word means.

On large work, the 24-in. or even 48-in. mahogany or oak square (Fig. 1) still holds its ground, and probably always will do so. It is much handier to use than an iron square of the same size, and

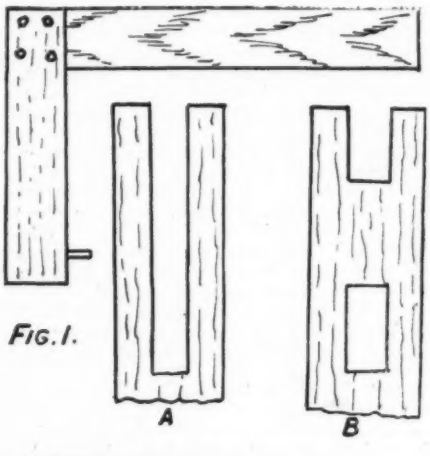

FIG. 1.

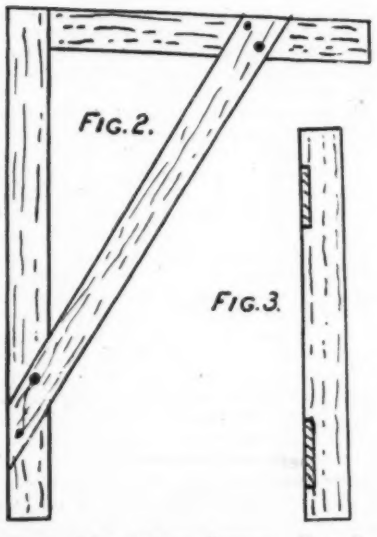

FIG. 2.

FIG. 3.

Fig. 1.—Hard Wood Square. Fig. 2.—Set Square. Fig. 3.—Straight Edge.

equally as accurate if it is frequently trued. The construction of such a square is not as simple as it would appear to be, and apprentices and many young journeymen pattern-makers find difficulty in making one satisfactorily.

The width of the blade and stock should depend on the size of the square; 2½ in. is a satisfactory width with a blade ¼ in. thick set into a stock about ¾ in. thick. The difficulty of the tyro is of course in jointing the blade and the stock, and if care is exercised there should be little difficulty in trueing up afterwards. The easier joint is that shown in Fig. 1 at A, which is the thickness of the blade, but the best joint is shown at B. It is more difficult to make, but if it is properly glued and afterwards dowelled it will never give way. The first-mentioned form of joint places too much reliance on the dowels. Before the blade is glued in position it is advisable to test the square on a drawing-board, and a good practice is to glue it with buttons—small blocks—fastened on both sides of stock and blade. After the glue has set, ¼-in. dowels can be driven in. It is quite an easy task to make such a joint, but not easy to make it well. If the blade is twisted in the stock accurate testing is impossible. A loose dowel set in the stock an inch or two from the end is a considerable help in using the square when setting down work, and it is a simple matter to pull it out when it is in the way.

The timber used for large squares should be thoroughly seasoned, and even so it is not desirable to make a square longer in the blade than 30 in. A very large square is awkward to handle, and if there is a slight curl on the blade unreliable, consequently for testing very large square faces, the level or plumb bob is preferable. A larger 45 deg. or 60 deg. set square is very handy in the pattern shop. One of these is shown in Fig. 2. Sometimes they are made in yellow pine, and as they can be easily trued up, it answers the purpose. Instead of mortising, the ordinary half-lap joint is employed.

No other method is quite as good as winding straight-edges for testing large planed surfaces. If two straight-edges exactly parallel are placed at either end of a planed surface and viewed the slightest inaccuracy can be detected. If two strips of wood of different colour from the straight-edges are inset into one of them (Fig. 3) and this is placed on the work at the end farthest away they constitute a distinct improvement.

The Influence of Recalescence on the Length of Various Wires.

In a recent issue of the "Revue Generale des Sciences," some interesting experiments were described by Messrs. J. Lemoine and M. Garvin. The apparatus employed is depicted in Fig. I., and consists essentially of two insulated supports three and a half meters apart. Between these supports wires of varying gauges were suspended and electrically heated. A nichrome wire of 1¼ mm. diameter on heating by means of 110-volt current elongated to the extent of giving a 25 cm. deflection. On cooling the wire returned to normal length. A hard steel piano wire of 1.2 mm. diameter expanded on heating to dark redness so that the deflection was about 15 cm. It then

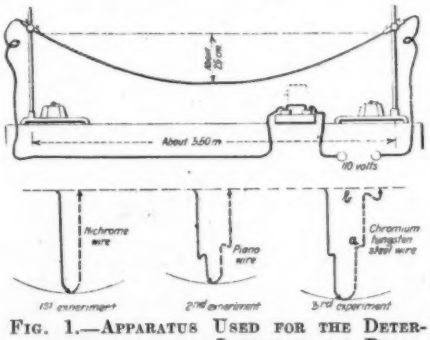

Fig. 1.—Apparatus Used for the Determination of the Influence of Recalescence on the Length of Wire.

contracted to 10 cm. and finally expanded to 20 cm. at cherry redness. During cooling, the wire contracts to a temperature below visible colour, when it exhibits the phenomenon of recalescence and finally regains its original length. A tungsten chromium steel wire of the usual high speed composition 3 meters long and 1.2 mm. diameter was also included in the experiments. On heating analogous results to those given by the piano wire were observed but at a slightly higher temperature. On cooling, however, two transformation points were shown. With slow cooling only one transformation point, corresponding to the first one at A, and with rapid cooling there would also be only one, but this would correspond to that at B.

Applications for Patents.

The names of communicators are printed in italic type. A new number will be given when the Complete Specification is accepted.

Bateman, L. H. Moulding-machines. May 25. 14,564.
Birmingham Battery and Metal Company, Limited, and Evans, G. Manufacture of weldless metal tubes. May 26. 14,671.
Blaisdell, F. E. Flexible metallic tubing. May 24. 14,423.
Efandem Company, Limited, and Cutler, F. E., and Eaton, J. Rotary magnetic separators for separating metals. May 28. 14,836.
Gwynnes Engineering Company, Limited. Lubrication of thrust, etc., bearings. May 24. 14,455.
Loke, J. J. Process for direct production of titanic-iron ores or slags. May 27. 14,813.
Lyons Oxy-Acetylene Economiser Company, Limited. Friction-lift drop stamps or hammers. May 24. 14,397.
Sylvette, Limited. Nickel alloys. May 26. 14,603.
Wardall, F. C. Aluminium alloys. May 25. 14,544.
Aktiebolaget Svenska Kullagerfabriken. Hardening of metal, and hardened metal articles. 15,840. June 8. (United States, June 15, 1920.)
Cammell, Laird & Company, Limited, Hague, A. P., and Middleton, T. Cementation of iron, steel, and ferrous alloys. 15,655. June 7.
Chemical & Metallurgical Corporation, Limited. Treatment of argentiferous lead-zinc sulphide ores. 15,815. June 8.
Collins, J. J. Treatment of ores. 16,157. June 11.
Durelco, Limited, Craig, E. N., and Pearson, R. E. Electrolytic treatment of metalliferous materials containing tungsten or molybdenum. 16,148. June 11.
Goldschmidt, H. Process for welding metals. 15,745 June 7. (Germany, April 9.)
Greenwell, W. Flexible tube-bending mandril. 15,901. June 9.
Jackman & Company, Limited, J. W., and Leigh, A. P. Machines for treating foundry sand, etc. 15,627. June 7.
Krupp Akt.-Ges., F. Presses for manufacture of sheet-metal end-plates. 16,026. June 10. (Germany, June 26, 1920.)
Lacell, H. G. Treatment of metal-bearing ores, etc., and recovery of valuable constituents thereof. 16,165. June 11.
Mooney, D. J. Metal-rolling shutters. 15,686. June 7.
Naish, W. A., and Norwood, C. R. Metal moulds or dies for casting metals. 16,152. June 11.
Perkins, W. G., Picard, H. F. R., Sulman, H. L., and Taplin, T. J. Treatment of ores containing copper silicate. 15,968. June 9.
Aikens, W. J. Process for electrolytic refining of tin. 15,047. May 31.
Aymard, M. F. L. A. Treatment of silica-bearing ores. 14,946. May 30.
Baxter, P., and Wood, W. E. Cutting and welding metals under water. 15,137. May 31.
Benedetto, A. Means for shaping sheets or bands of metal, etc. 15,504. June 4.
Caut, R. Hydraulic power-transmission systems. 15,134. May 13. (France, June 22, 1920.)
Clayton & Shuttleworth, Limited. Water-tube boilers, etc. 15,319. June 2.
Drägerwerk H. & B. Dräger, and Dräger, A. B. Burners for autogenous cutting of metals. 15,229. June 1. (Germany, June 2, 1920.)
Hungenberg, P. Flame-tube steam-generators, and furnaces therefor. 15,532. June 4.
Hutchison, G. H., and McLean, D. S. Hydraulic pumps and transmission gear. 15,189. June 1.
Jaick, K. Manufacture of twist drills. 15,361. June 2.
Leon, K. O. Chain hoists. 15,456. June 3.
Manbrê, G., and Walker, I. F. V. H. Mechanical hammers, etc. 15,277. June 2.
Marks, A. W. Metal-cutting, etc., files. 14,982. May 30.
Marshall, V. M. C. Anti-corrosive and anti-fouling compositions for metals. 15,174. June 1.
Maschinenfabrik Rheinland Akt.-Ges. Ball or roller bearings. 14,990. May 30. (Germany, May 31, 1920.)
Mathison, G. Spring bolt or catch. 15,040. May 31.
Ritchie, Hart & Company, Limited. Making cores for cylindrical castings. 15,306. June 2.
Talbot, B., James, J. E., and Williams, T. H. Manufacture of steel or iron joists. 15,329. June 2.
Aluminium Company of America, and Bloxam, A. G Aluminium alloys. 16,263. June 13.
Ashton, T. R. R., and Hunton, R. S. Metal slitting or cutting machines. 16,638. June 16.
Bamburg, G. Means for locking nuts on bolts, etc. 16,486. June 15.
Cross, W. A. Method of removing rust from iron or steel surfaces. 16,632. June 16.
Dent, W. C. K., and Seddon, J. W. Alloys for repairing defective castings and machinery. 16,818. June 18.
Dräger, A. B. Burners for autogenous cutting of metals. 16,751. June 17. (Germany, September 10, 1920.)
Griffiths, H. Process of tinning on steel or copper sheets, etc. 16,662. June 17.
Gwynnes Engineering Company, Limited. Priming centrifugal and rotary pumps. 16,413. June 14.
Hage, R. A. Mechanical hammers. 16,225. June 13. (Sweden, June 15, 1920.)
James, J. E. Means for moulding metallic sockets, cylinders, pipes, etc. 16,382. June 14.
Linley, C. M. Tools for turning, shaping, and planing metal. 16,702. June 17.
Longworth, R. H. Furnace fronts. 16,318. June 14.
Mandler, E. Centrifugal fans or blowers. 16,237. June 13. (Austria, June 12, 1920.)
National Lead Company. Corrosion of lead. 16,404. June 14
Nussey, G. Nut-lock. 16,179. June 13.
Peck, W. F. Machine for bending or doming sheet metal. 16,459. June 15.
Weiss, L. Centrifugal fans or blowers. 16,237. June 13. (Austria, June 12, 1920.)
Zynkara Company, Limited. Method of removing rust from iron or steel surfaces. 16,632. June 16.
A1. Manufacturing Company and Hadley, C. A. Welding. June 22. 17,081.
Bechler, A. Thread gauges for screws. June 21. 17,032.
Capdeville, J. E. Smelting tin ores. June 23. 17,257.
Frost, W. Machine for operating on metal plates, etc. June 21. 16,940.
Harris, H. Apparatus for refining metals. June 20. 16,871.
Holroyd, J., & Company, Limited, and Liebert, H. A. E. Machines for cutting and slicing ingots. June 23. 17,164.

Italian Boat Building Requirements.

The small port of Varazze, near Savona, with its boat building enterprises, is a market which, in the opinion of His Majesty's Vice-Consul at Savona should not be overlooked by United Kingdom manufacturers of materials suitable for this industry. The Vice-Consul has furnished the Department of Overseas Trade with the names of three firms who, he states, are fairly well employed notwithstanding the general depression and who would be glad to receive current quotations for ship materials, such as sheet copper, anchors, chains, wood working tools, nails, screws, rivets, metal fittings, spruce, mahogany, yacht and sailing ship sails and oil engines and motors.

The names and addresses of the firms mentioned may be had by United Kingdom manufacturers and exporters on application to the Department of Overseas Trade, 35, Old Queen Street, Westminster, S.W.1., quoting the reference D.O.T. 11,199 FW/PN.

Mining Plant For Canada.

We are informed by the Department of Overseas Trade that a letter has been received from His Majesty's Trade Commissioner at Toronto, (Mr. F. W. Field), in which it is stated that an Ontario Mining Company are desirous of entering into communication with United Kingdom manufacturers of 1-in. hexagon hollow drill steel mining hoisting cables, 1-in. and 1½-in. diameter 6 x 19 Langs Lay, steel hardening furnaces, electric mine hoists for a depth of 2,000 ft. and general mining supplies. Apparently the firm is not actually in the market at the moment but it is stated that they make regular purchases of the goods enumerated. It may be stated that they are the proprietors of one of the oldest mines in Ontario and that they are said to enjoy a good reputation and to be well regarded financially. The name and address of the applicants will be furnished to United Kingdom manufacturers and exporters on application to the Department quoting E.D./5991.

CHINESE IRON ORE.—Ni Yu Tan of the I Hua Iron Mining Company of Anhui is planning to open mines at Lung Chia Shan as soon as the Ministry of Agriculture and Commerce grants its registration.

XUM

Metallurgical Possibilities in Brazil.

The Commercial Secretary to His Majesty's Embassy at Rio de Janeiro, (Mr. Ernest Hambloch) has forwarded to the Department of Overseas Trade some notes on the Brazilian President's message to Congress at the opening of the first session of the new legislature. The President dealt at some length with the subject of the utilisation of Brazil's immense resources of coal and iron, and said that with a view to establishing not only the possibility of the manufacture of metallurgical coke from Brazilian coal, but also the cost of production of pig-iron and steel in electric furnaces either with national coke or with charcoal, the Government sent to Belgium several tons of coal from the mines in Santa Catharina and Rio Grande do Sul, and appointed a professor of the Curo Preto School of Mines to accompany and control the tests in first-class establishments. In the Coppee works of Belgium metallurgical coke has been manufactured from Brazilian coal. The technical data verified are highly satisfactory: 600 kilos of coke of good resistance per ton with 18 per cent. of ashes, and, further, 59 kilos of tar, 12 of benzol, 14 of sulphate of ammonia, and 230 cub. metres of gas with 4.760 calories.

The percentage of coke, 60 per cent., although not very high, gives ample scope for industrial exploitation, especially if the quantity of the valuable by-products, benzol and sulphate of ammonia, which is double what is generally found in Belgian coal, be taken into consideration.

The second part of the demonstration, viz., the manufacture of pig-iron and steel from Brazilian ore and Brazilian metallurgical coke or charcoal, is to be carried out in electric furnaces in Sweden, to which country the necessary coal has also been sent.

The Brazilian Government anticipate that they will as a result of these tests be in a position to appreciate in all its details the elements on which the Brazilian iron industry can count, and be able to determine with certainty the conditions of its vitality and progress.

Whatever may be the definite course which this industry may take in Brazil, the great influence which the employment of electric furnaces may also have on it is incontestable. For this reason the Government, simultaneously with the tests which have been made in Europe, is taking stock of the hydro-electric wealth of Brazil, and studying the technical conditions of its waterfalls, especially from the point of view of their application to the siderurgical industry.

Present State of the Iron Industry.

The Esperanca (Usina Esperanca) in Minas Geraes continues to be the only source of supply for national foundries and mechanical works. Its production of pig-iron is approximately 15,000 metric tons per annum. At the present moment tests are being made of the manufacture of steel in a small Bessemer converter. This company hopes to erect within a short while small works for the manufacture of steel in an electric furnace.

One electric furnace is at present in existence in Sao Paulo, with a capacity of 1,000 kilogrammes, for the manufacture of steel from pig-iron and "sucata," and besides this there is another small electric furnace for the smelting of pig-iron for moulds. The operation of this small furnace became necessary in view of the high price of foundry coke since the war.

It is stated that the Companhia Electro-Metallurgica Brasileira will by the end of the year have in operation at Ribeirao Preto a factory for rolled steel, and be able to produce everything from pig-iron in electric furnaces with charcoal to the most complex siderurgical operations.

The Anglo-Brazilian Iron and Steel Syndicate also intend to erect not far from the city of Rio de Janeiro iron and steel works which will employ electro-siderurgical methods.

The wages of all workers in Sheffield rolling mills and forges are to be reduced on August 2 as a result of a conference between representatives of two employers' associations and representatives of six trade unions, which include in their membership every worker from the skilled man to the labourer.

New Process for Extracting Metal.

According to Mr. H. W. Adams, representative of the United States Department of Commerce in Berlin, writing in "Commerce Reports," a new process which furnishes a simple, rapid, and effective method of separating alloys into their metal components and extracting metals from mineral ores, has been invented in Germany by Mr. H. Paulin, a Berlin engineer. In this process, metals treated with the catalytic agent very quickly go into solution, large blocks of metal being treated in less than 30 minutes. Out of the solution thus obtained the various metals are dissected by the employment of simple methods of chemical reaction, which permit the retaining of the metals one by one. The product first obtained is in the form of a muddy sediment which yields, after drying, a metal powder ready to be used or melted in crucibles, or to be treated by electrolytic process. Metals and concentrated ores require one or two more operations than pure metal alloys. It is stated that the greater part of the catalysator employed is recuperated in the process and used again, an added advantage being that the catalysator is easily procurable in any quantity.

It is claimed that the general expenses involved are relatively small, while the workmen necessary for the simple installation and appliances require no special experience. The process is effective with any number of metal components, every metal being recuperated separately, and in the case of concentrated mineral ore every component metal part being retained one by one in pure form.

The inventor has also developed a new process for the electrolytic treatment of metals, which enables one to procure copper wire directly out of the electrolytic bath, thereby eliminating the melting down of the electro blocks obtained under the old process, the rolling into plate, and drawing into wire.

Mr. Walter P. White of the Geophysical Laboratory, Washington, has shown the latent heat of Nickel to be 73 calories per gram. This is 17 calories greater than the recent determination of Wust. For a normal metal, 68 calories per gram was the figure found, and which is in excellent agreement with that of nickel.

CHINESE TUNGSTEN.—The Chinese Government has decided through the Ministries of War and Agriculture and Commerce to monopolise the tungsten output of Kiangsi. Merchants will do the prospecting on behalf of the Government and the output will be disposed of officially. Wolfram deposits have been found in Chihli, Hunan, Kiangsi, Fukien, and Kwangtung. The mineral is largely worked in the following districts of Kiangsi: Tsungyi, Tayu, Nankang, and Shangyiu. The Tungsten resources, however, of China are more or less a matter of speculation.

MATERIALS REQUIRED FOR TRINIDAD.

His Majesty's Trade Commissioner at Trinidad reports to this Department that he has received an inquiry for catalogues and current prices of steel indented bars and concrete specialities such as stirrups, column reinforcements and expanded metal. Similar particulars are required in regard to sanitary goods in connection with which it is suggested that quotations should be sent for complete lavatory and water-closet outfits, which, to compete with American supplies, should be cheap but efficient. The firm have been obliged to obtain from the United States most of the material required for a two-storey concrete building which they are erecting, but they are now anxious to ascertain how far such supplies can be obtained from the United Kingdom at competitive prices in view of the comparatively large supplies which are likely to be required in Trinidad in the near future. The Port of Spain City Council has under consideration the erection of 1,000 cottages at Woodbrook, and the number of Customs warehouses is to be increased in the near future. The name and address of the firm referred to may be obtained by United Kingdom manufacturers and exporters on application to Department of Overseas Trade, quoting the reference 6083/ED/SC(2).

Trade Talk.

NEW SOUTH WALES overseas trade for the year ended June last totalled £122,385,476, being an increase of £24,538,206 over the previous year.

THE IMPERIAL MINERAL RESOURCES BUREAU has got actively to work, and, in addition to the valuable digests that have already appeared, it has now issued one on Tungsten (1913-1919).

THE text of the Safeguarding of Industries Bill as amended in Committee has just been issued, the schedule showing a complete list of goods chargeable with duty.

THE NUMBER of wholly unemployed on the "Live" Registers of the Employment Exchanges throughout the United Kingdom on July 15 was 2,020,300, being a decrease of 102,000 compared with the previous week.

MESSRS SWAN, HUNTER & WIGHAM RICHARDSON, LIMITED, have launched from their Wallsend shipyard a fine tankship for carrying oil in bulk. She is called "Scalfaria," and is being built for the Anglo-Saxon Petroleum Company, Limited, of London.

THE NATIONAL ENGINEERING COMPANY, 549, W. Washington Boulevard, Chicago, U.S.A., have lately developed and have placed on the market, a new and larger size of their Simpson sand mixer, which they call their No. 3 size, and which has an 8 ft. diameter pan.

A NATIONAL APPEAL has been made by the Prince of Wales to the heads of public bodies throughout the United Kingdom in support of the British Empire Exhibition. The response to that appeal will determine whether the exhibition, which has the financial help of the Government, will be held in 1923 or at all.

IN REGARD TO THE REDUCTION of wages in the engineering industry, Markham & Company, Limited, of the Broad Oaks Works, Chesterfield, have intimated that they will not reduce wages, but that they will require their employés to put in 47 hours per week instead of 44, as at present.

WORK to the value of considerably over £100,000 is waiting for Southampton, states a news agency, the Admiralty having notified that they are about to recondition a number of transports which, under normal circumstances, would be refitted in that port. Whether this is accepted or not depends on the ship joiners, who are still on strike.

THE Board of Trade issued last Thursday, as a supplement to the "Board of Trade Journal," the draft of the proposed new Spanish tariff. The draft tariff is published for general information, and, up to September 8, the Spanish Customs Board will be prepared to receive representations and petitions on the subject of the tariff proposals.

ACCORDING to information circulated by the Board of Trade, 187,134 tons of steel bars, rods, angles, shapes, and sections were imported into this country during the year ended April 30 last, while 314,632 tons were exported. For May, 1921, the totals were :— Imports 12,873 tons, exports 4,851 tons; and for June, 10,737 and 2,115 respectively.

THE STAVELEY COAL AND IRON COMPANY, LIMITED, near Chesterfield, state that their pipe foundries are now able to resume active operations, and they will be pleased to receive inquiries for any cast-iron pipes required. Deliveries can be given out of stock of standard sizes, and new pipes of all diameters can be promptly manufactured.

THE NATIONAL ASSOCIATION OF MASTER HEATING AND DOMESTIC ENGINEERS announce that a joint recommendation for certain wages reductions has been unanimously adopted by the Council of the Association, and that the ballot of the members of the National Union of Operative Heating and Domestic Engineers has resulted in favour of the recommendation by a majority.

A CONFERENCE of employers and trade union officials, arranged by the Birmingham Branch of the Industrial League and Council, was held recently at Birmingham, the subject of discussion being a paper by Mr. Robert Stelling on "Industrial Waste of the Past and Present." He dealt with the question from the point of view of the responsibility of managers, foremen and workmen in relation to waste of time and materials in the management of factories and in the workshops.

IN CONNECTION WITH THE standardisation of contract forms, an inquiry into which has been instituted by the Federation of British Industries, it was decided at the last meeting of the full committee that a small sub-committee should be formed to investigate the fundamental clauses essential to all contracts and to report to the main committee. The following gentlemen were asked to serve : Mr. Thomas Biggart (chairman), Mr. D. A. Bremner, B.E.A., Mr. D. N. Dunlop, B.E.A.M.A., and Mr. M. Mannaberg, National Federation of Iron and Steel Manufacturers.

THE NATIONAL ASSOCIATION OF MERCHANTS AND MANUFACTURERS, of which Sir Hugh Bell, Bart., is chairman, has issued an appeal, signed by over 800 members of the principal industries of the country, on the lines of the appeal made by the bankers of the United Kingdom in May last. The appeal reads :— We, the undersigned merchants, manufacturers, and shipowners of the United Kingdom, desire to endorse the weighty appeal by leading bankers issued on May 12, and to insist with them on the need of dealing promptly with the perilous situation in which the country is placed. The appeal, which opens by recalling the Petition of the Merchants of the City of London addressed to the House of Commons in 1820, dwells on the parallel between the state of the country then and now. At the present juncture the following problems seem to call most urgently for attention :— An immediate and drastic reduction of expenditure is of vital importance; the freeing of our trade and industry from the trammels imposed by the war is not less essential; the interference with our commerce, whether by Parliament or by the Administration, must be stayed at once; but it is perhaps even more important that the inhabitants of this country should be impressed with the absolute need for greater industry and greater thrift so that the wealth annihilated by the war may be restored. Such restoration can only be accomplished by earning more and spending less. By these means alone shall we be able to bear the burdens from which we suffer, to regain the foreign trade essential to our prosperity, and to contribute to the well-being, not only of our own country, but of all other countries on which we are largely dependent. We invite our fellow countrymen to join with us in impressing on the Government, on Parliament and on the nation at large, the paramount importance of these great questions.

Gazette.

AT the Sheffield County Court his Honour Judge Adshead Elliott has made an order for the winding up of Brannan & Garnett, Limited, tool makers, of 94a, Scotland Street, Sheffield.

MESSRS. W. J. THOMSON and G. R. Dawson, trading as Trogan Engineering Company, Hickman Street, Wednesfield, engineers, have dissolved partnership. Debts by Mr. G. R. Dawson, who continues the business.

MESSRS. A. H. O. WALKER and T. Storey, trading as A. O. Walker & Company, Norton Street, London Road, Liverpool, electrical and mechanical engineers, have dissolved partnership. Debts by Mr. A. H. O. Walker, who continues the business.

MESSRS. J. H. HUMPHRYES and A. Anderson, trading as Braithwaite & Company, 117, Victoria Street, Westminster, and elsewhere, constructional engineers, have dissolved partnership. Debts will be paid by Messrs. Braithwaite & Company. Mr. J. H. Humphryes continues the business.

THE business of Messrs. J. Crawhall, J. S. Crawhall, E. Slater and T. Robinson, trading as the Billing Ganister and Mineral Company, Billingshield, near Stanhope, has, on the death of Mr. J. Crawhall, been sold and transferred to Mr. W. S. Walton and Mr. H. Copeland, Custom House Chambers, Newcastle-on-Tyne, and will be continued by them under the above title. All debts due and owing to or by the said late firm will be received or paid by Mr. J. S. Crawhall.

Publications Received.

"THE INDUSTRIAL LEAGUE AND COUNCIL JOURNAL," July, 1921, price 3d. 82, Victoria Street, S.W.1.

MESSRS. BYWATER & COMPANY, 121, Kingsway, London, W.C.2. "Bywater's Hydraulic Petrol Storage System."

THE INDUSTRIAL WELFARE SOCIETY, 51, Palace Street, London, S.W.1. "The Journal of Industrial Welfare," July, 1921, price 9d.

THE GENERAL ELECTRIC COMPANY, LIMITED, Magnet House, Kingsway, W.C.2. "Electrical Plant, P. Section." 14th edition.

MESSRS. PRIEST FURNACES, LIMITED, Engineers and Furnace Builders, Middlesbrough. "The Priest Patent Saturated Fan Blast System as applied to Foundry Drying Stoves."

MESSRS. HAYDOCK, MOLINEAUX & COMPANY, LIMITED, Foster's Buildings, Sheffield.—"List of Colliery and Mill Supplies," for which they have recently opened a new department.

JOSEPH WRIGHT & COMPANY, LIMITED, Tipton.—A chart, which is specially useful for foundrymen, as it tabulates, by means of moveable fingers, the size of slings to use for graduated loads and angles.

MESSRS. DONOVAN & COMPANY, 47, Cornwall Street, Birmingham. "Price List No. 1,421," descriptive of requirements for ordinary electrical installations for housing schemes, private house and works wiring, etc., which will be sent to any of our readers interested upon receipt of postcard.

XUM

IRON AND STEEL MARKETS.

Pig-iron.

Reports from all the chief centres of pig-iron production indicate a generally pessimistic view of the trade and its early recovery from the period of depression, the already limited volume of business permissible having been further restricted by holiday interruption, while, with few exceptions, furnaces everywhere remain idle. The position is, in fact, unparalleled in the records of the industry, and in the existing conditions it is difficult to perceive any alleviating features affording hope of a satisfactory solution of the deadlock in the trade. In Lancashire, the position in the foundry iron market is much as it was. No. 3 foundry iron is very scarce, and consumers have to pay up to £9 if they want any of the Midland irons; but Continental pig-iron can be obtained at a fairly reasonable rate. Generally speaking, smelters will wait until the price of fuel is low enough to enable them to make iron at a profit at £6 per ton, but so far as can be seen there is not likely to be any sufficient market for British pig-iron, even if it can be made at £6. In the West of Scotland there are as yet no signs of re-starting production of pig-iron, except in the cases of furnaces attached to steel works, which may be put into operation shortly. Fuel is still a serious handicap in production, and although quotations for coal have already been reduced, and show unmistakable signs of still further modifications, there is still a long way to go to bring the price down to the level required by the pig-iron makers. At the same time, it must be very hard for those makers who have a good connection to stand idly by, whilst customers whom they have had on their books for many years are forced to try other brands, which they may find just as suitable for their requirements. In the Cleveland market the general depression in trade and the high cost of fuel are the dominating factors. Although several blast furnaces have already been re-started, or are on the point of going into blast, on Tees-side, the basic product of the majority is exclusively for the steel works, and most of the output of the others, which will be on Cleveland foundry iron, will not come on the market. In the meantime, the business passing from the small quantity of No. 3 Cleveland now available is all but negligible. For July delivery, 135s. is quoted, while the price demanded for August is 140s., with a premium of 5s. per ton for export. This puts export business right out of count, for Continental foundry iron, large quantities of which are being bought in this country, is selling c.i.f. British ports at round about £5 per ton. There is no change in the quotations for the lower grades, No. 4 forge and mottled being 117s. 6d., and white iron 115s., but the demand for these descriptions is very feeble.

The furnaces on hematite are still idle, and the present position of business, not to speak of the prohibitive cost of fuel, does not encourage resumption. The home demand is extremely quiet, and it is questionable whether even a reduction of the price of mixed numbers by 20s., bringing them down to the export level of 140s. per ton, would have any considerable present effect. Inquiry from abroad is very feeble, and the big increase in the Italian import duties will further depress business with that country.

Finished Iron.

Stagnation in most branches of the finished iron trade continues unrelieved, and although some work is passing through the bar mills, orders in this department are mostly confined to marked qualities, for which a certain demand is still in evidence. In South Staffordshire the market is quite idle for other kinds of finished iron, which cannot be made at a price to meet consumers' ideas, with the result that all the demand there is is being supplied from foreign sources. For instance, imported nut and bolt iron can be obtained for under £10 delivered, this being pounds a ton below anything the Midland maker can contemplate. The local product has also been displaced to some extent by imported steel. Altogether the position is about as unpromising as it could possibly be. Prices remain nominally unaltered, but those of crown iron and gas strip are quite impracticable. The imports of iron, steel, etc., at Hull from abroad during the past week were :—Iron : Pig, 100 tons (Wilson's and N.E.R Company), 6½ (Ellerman's Wilson Line); bars, 18½ tons (Wilson's and N.E.R. Company); bar-ends, 15 tons (Furley & Company); plates, 50 tons (Hull and Netherlands S.S. Company). Steel (blooms, etc.) : 25 tons (Ellerman's Wilson Line), 11 tons (Hull and Netherlands S.S. Company), 31 tons (Wilson's and N.E.R. Company). Zinc : Plates, 5 tons (Wilson's and N.E.R. Company); sheets, 4 tons (Hull and Netherlands S.S. Company). Grimsby :—Iron : 20 tons pig, 619 bars. Steel : 128 plates, 379 billets, 33 joists. Goole :—Iron : 571 tons pig, 4,000 bars, 603 plates, 1,566 sheets. Steel : 425 billets, 411 joists, 61 girders, 617 sheets, 159 blooms, 874 bars. Spelter : 1,003 ingots.

Tinplates.

Business in the tinplate market continues in an unsatisfactory position, and although additional mills have recommenced operations, the outlook of the trade is far from reassuring, production being almost solely confined to stock plates only. There is not much forward business passing, and although there has been a little more inquiry of late, the margin of difference between buyers' and sellers' ideas is considerable. Makers' figures for September-October range from 25s. to 26s. basis for cokes, but merchant sellers are to be found at 2s. and more, a basis box below these figures, consequently, such orders as are coming in are being taken by merchants who will try to get them placed to show them a profit later on. In the meantime producers declare they cannot make a profit at the figures they are quoting. Tinplates are quoted 23s. 6d. to 24s. basis for usual specifications, but business is exceedingly slow. Stock plates are in most demand, coke prices realising 27s. 6d. basis easily for 14 x 20 and 28 x 20. Wasters are in demand at 40s. for 28 x 20, and 16s. 3d. for 14 x 18¾. All net f.o.t. at works.

Mr. Spence Thomas, managing director of the Melingriffith Company, Limited, takes a serious view of the possibilities in regard to German competition, particularly in the tinplate industry. Mr. Thomas has just returned from an extensive Continental tour, and he has been greatly impressed by what he describes as "the wonderful activity of the German people and the happy appearance of all the workers." In the course of an interview, Mr. Spence Thomas pointed out that at the time when thousands of British workshops were closed and the work of reconstruction was practically at a standstill owing to the miners' strike, German machinery of every description was busy making up for lost time. There have been very few strikes in Germany since the war. "It is significant," said Mr. Thomas, "that although only half the tinplate mills are working, they are producing something like 1,500 boxes per mill per week. Then, with regard to wages, the tin-men are paid 60 marks per day of eight hours and produce about 40 boxes. That gives a cost on the present rate of exchange of 1½d. per box, as against about 6d. per box paid in the mills of this country. We are, therefore, paying about four times as much for the same work. In my opinion, our salvation lies in the strictest habits of thrift in every direction, in reducing cost and increasing production, thus enabling our goods to be marketed cheaply and permitting us to buy our food cheaper from abroad. We must get back and improve upon pre-war production and cost, and this can only be brought about by thorough co-operation betwe n all concerned in the tinplate trade."

Steel.

Though necessarily slow, some progress towards renewed activity in the steel trade is plainly observable, fuel coming forward in more ample supplies, and a more reasonable disposition on the part of the workpeople in the matter of wages constituting hopeful factors in the industrial position. In the Sheffield district a number of furnaces have already been put in commission. These include two at Messrs. Cammell, Laird & Company's works at Penistone, three at the same firm's works at Grimesthorpe, two at Messrs. John Brown & Company's, four at Messrs. Vickers, Limited, three at Messrs. Steel, Peech & Tozer's, four at the Parkgate Iron and Steel Company's works, and four at Messrs. Fox's at Stocksbridge. The crucible steel melting trade is still bad, but work is decidedly more brisk at the smaller rolling mills, and in certain instances the larger mills have recommenced operations. Most of the engineering branches are short of work. Electrical engineers are better off than some of the others, but with them new contracts are hanging fire. Development is retarded in the railway carriage and wagon industry by want of confidence in the present range of prices. Risks have been undertaken in the endeavour to meet buyers, but the general subsidence in production costs must go a good deal further before there can be any considerable development. In the machine tool shops a revival seems as far off as ever. As a further indication of industrial revival, it is reported from the West of Scotland that three large furnaces have been relighted at Messrs. Colville's Clydebridge steel works, while on a somewhat smaller scale there will be a resumption at the Steel Company of Scotland's Hallside works. It is reported that steelmakers have fairly good orders, which they will not begin to execute until they secure cheaper coal. An effort has been made by Sheffield crucible steel manufacturers to revert to the three-round day in the industry. The workers have agreed to a substantial reduction in their wages, amounting to 1s. 2d. per shift and 6s. per week, while three rounds from Monday to Friday and two rounds on Saturday have also been agreed to. On the North-East Coast the position as regards new business in steel shows no improvement. Consumers, faced by depression in their own trades,

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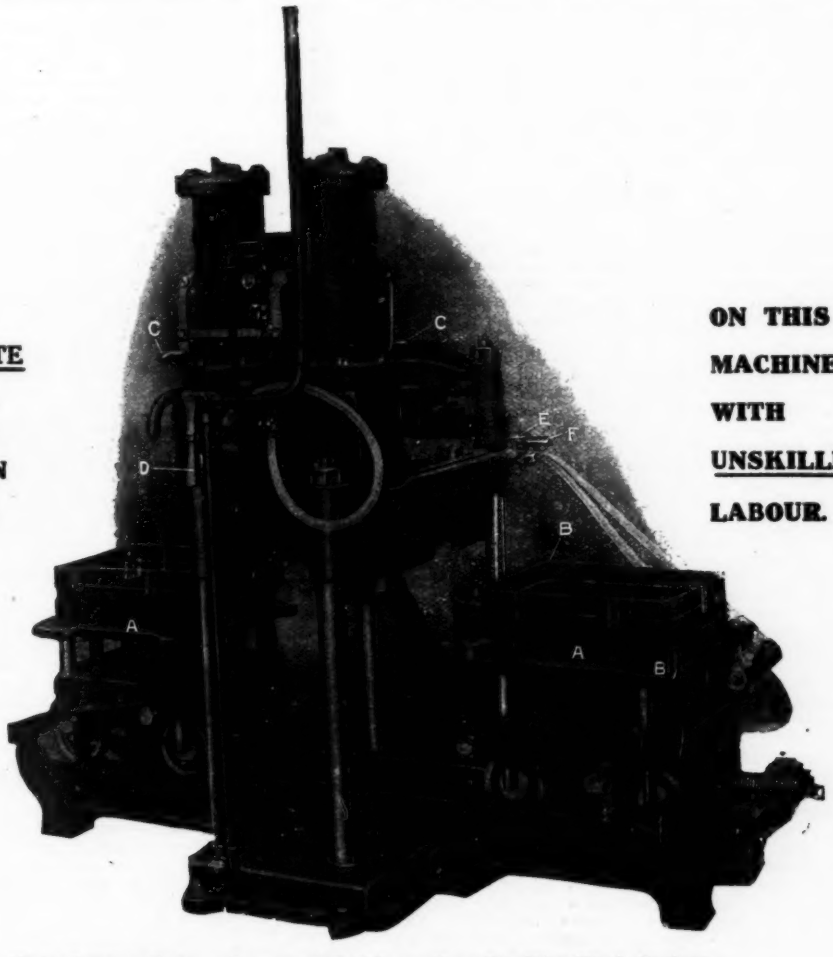

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One of many that we have installed in various Munition Work Centres.

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and by the high cost of fuel, are holding off, and the volume of new orders coming out is extremley disappointing. A few works with contracts in hand have got into operation again, but a general restart can hardly be looked for for some months to come.

Scrap.

The extreme depression in the market for iron and steel scrap continues unabated, and very few attempts at reopening business can be reported on the part either of buyers or sellers. Consumers, generally, hold ample stocks, or have already bought ahead, and until consumption is again actively resumed there can be no market for this class of material. In South Wales, prices, delivered works, are quoted nominally as follow : Heavy steel scrap, £3 10s. ; steel turnings, £2 5s. ; cast-iron borings, £2 5s. ; heavy wrought-iron scrap, £3 ; heavy cast-iron scrap, £5 10s. to £5 15s. There have been a few inquiries for steel scrap, with as high as £3 10s. per ton delivered works offered, but naturally there will be very little selling, even at this figure, as merchants consider this price inadequate for negotiation.

Ore.

After three months' complete stagnation, it is now possible to hope for some revival of business in the foreign ore market. But this, of course, will depend upon the resumption of pig-iron manufacture, with regard to which there is some ground for taking a fairly cheerful view. But most consumers are well stocked, and will be in no hurry to commit themselves. In the total absence of business, it is not possible as yet to name a figure at which business, based on best Bilbao rubio, is likely to settle down.

Metals.

Copper.—Dealings in last week's markets for copper were subject to holiday influences, and the volume of business transacted was in consequence comparatively unimportant. Standard copper after an earlier decline remained steady during the week, and subsequently firmed up, closing at £70 5s. cash, £70 12s. 6d. three months, early August, £70 10s., mid-September and two months, £70 10s to £70 12s. 6d. three months. Electrolytic and wirebars were unchanged at £75 to £77. Best select, £70 10s. to £72 10s. Sheets, £105. Closing prices :—Cash, Wednesday, £70 ; Thursday, £70 ; Friday, £70 5s. ; Monday, closed ; Tuesday, £70 5s. Three Months.—Wednesday, £70 7s. 6d. ; Thursday, £70 7s. 6d. ; Friday, £70 12s. 6d. ; Monday, closed ; Tuesday, £70 12s. 6d.

Tin.—With very little change to report during the past week in the general position of the market for tin, both consumers and dealers in the States have been tempted by lower quotations for the metal (partly due to the weakness of sterling exchange) to buy more freely than for some little time past. Standard tin has moved irregularly, with buyers at £159 15s. cash, £161 15s. three months, early August, £161 early September, £162 to £162 5s. to £161 15s. late October and three months. £166 was paid for B.O.D., and 10s. premium for Straits. English ingots sold £160. Closing prices :—Cash : Wednesday, £158 5s. ; Thursday, £159 5s. ; Friday, £159 15s. ; Monday, closed ; Tuesday, £158 10s. Three Months : Wednesday, £160 5s. ; Thursday, £161 5s. ; Friday, £164 15s. ; Monday, closed ; Tuesday, £160 10s.

Spelter.—There was a gradual revival of inquiry among consumers, though the volume of business passing is small. Transactions on the London market have been restricted to 800 tons for the past week, and values closed lower by 10s. per ton. On Friday only 25 tons were done at £26 for September. Closing prices :—Wednesday, £25 17s. 6d. ; Thursday, £25 17s. 6d. ; Friday, £26 10s. ; Monday, closed ; Tuesday, £25 10s.

Lead.—In common with other sections of the metal markets business in lead has been quiet of late, but some transactions for export have been recorded. On the whole, values have displayed an easy tendency, and at the week-end July was 15s., and October 12s. 6d. lower than on the previous Friday. English closing prices :—Wednesday, £24 10s. ; Thursday, £24 15s. ; Friday, £24 15s. ; Monday, closed ; Tuesday, £25.

Electric Furnaces in America.—The total number of electric furnaces in the United States at the end of 1920 was 356, as compared with 323 at December 31, 1919, and 287 at December 31, 1918.

The British Thomson-Houston Company, Limited, of Rugby, have recently found it necessary to extend their Manchester branch. Additional premises have been secured at National Buildings, St. Mary's Parsonage, in order to provide more room for the display and storage of the company's Mazda lamps, fittings, reflectors and accessories.

Company News.

Mather & Platt, Limited.—Interim dividend, 3 per cent. actual, less tax.

Consett Iron Company, Limited.—Final ordinary dividend, 1s. 2d. per share.

Consett Spanish Ore Company, Limited.—Final dividend, 2s. 6d. per share.

Allen-Liversidge, Limited.—Interim dividend, 10 per cent. per annum, less tax.

Mond Nickel Company, Limited.—Ordinary dividend, 1s. per share, free of tax, for year.

Hadfields, Limited.—Interim ordinary dividend, 6d. per share (2½ per cent.), free of tax.

Engineers & Ironfounders, Limited.—Interim ordinary dividend, 20 per cent. per annum, less tax.

National Gas Engine Company, Limited.—Ordinary dividend, 7½ per cent. per annum, less tax, for half-year.

Hills Dry Docks and Engineering Company, Limited.—Interim ordinary dividend, 10 per cent. per annum, less tax.

"Steelgrip" Fittings, Limited.—Capital £10,000 in £1 shares. Registered office : 32, Alfred Place, Tottenham Court Road, W.C.1.

Rennie Ritchie and Newport Shipbuilding Company, Limited.—Profit, £25,010 ; in consequence of uncertainty of trade directors recommend this be carried forward.

W. & T. Avery, Limited.—Old ordinary dividend, 10 per cent., less tax, for half-year (making 15 per cent. for year) ; new ordinary dividend, 7½ per cent., less tax ; reserve, £20,000 ; carried forward, £25,020.

Fellows Magneto Company, Limited.—Net profit, £31,960 ; brought forward, £5,772 ; available, £37,732 ; interim dividends, 8 per cent. preferred and ordinary shares paid ; no further dividends recommended ; credit balance, £24,332, carried forward.

George Howard, Limited.—Capital £15,000 in £1 shares, to take over the business of iron, steel and metal merchants carried on by G. C. Howard, A. Howard, W. H. Howard, and A. E. Howard at Folly Lane, Warrington, as George Howard. Registered office : Folly Bridge, Warrington, Lancs.

Normanby Iron Works Company, Limited.—Interest received and income, £14,764 ; debenture stock interest, £2,263 ; directors' fees, etc., £1,336 ; brought forward, £981 ; preference dividend, 6 per cent. for year, £3,600 ; ordinary interim dividend, £3,600 ; final ordinary dividend, 6 per cent., making 12 per cent. for year, £3,600 ; carried forward, £1,346.

Brightside Foundry & Engineering Company, Limited.—Report for 1920 :—Profit, £17,847 ; brought forward, £2,028 ; available, £19,875 ; interim preference dividend, 5 per cent., £1,125 ; final preference dividend, £1,125 ; ordinary dividend, 10 per cent. per annum, free of tax, £8,340 ; special depreciation and extensions, £2,000 ; reserve account, £5,000 ; carry forward, £2,285.

Deaths.

Mr. R. Monroe, lately general manager of the Barry Graving Dock and Engineering Company, Limited, died on July 22.

The death occurred at Swansea last week of Mr. Charles H. Eden, managing director of the firm of Vivian & Sons, copper smelters, Swansea, and a brother of the Bishop of Wakefield.

The death has taken place, suddenly, at his residence, Oakleigh, Underhill Road, Cleadon, of Mr. James H. S. Shaw, chief instructor in engineering at the Marine School, South Shields.

Mr. C. J. Wills, chairman of the firm of C. J. Wills & Sons, Limited, and managing partner of Messrs. Price, Wills & Reeves, public works contractors, of Victoria Street, Westminster, S.W., has died at the age of 73.

Mr. D. H. Thornton died at Harrogate on July 13, aged 55. Mr. Thornton was chairman and managing director of the Shipley Tank Company, Limited, Bowling Ironworks, Bradford, and his two sons are interested in that business, the elder, Major W. H. Thornton, having been a director for some years, has now become chairman and managing director in succession to his father.

The Institution of Mining and Metallurgy have removed from 1, Finsbury Circus, E.C.2, to Cleveland House, 225, City Road, London, E.C.1.

Electric Pig-iron in Brazil.—The Compania Electro Metallurgica Braziliera have acquired the exclusive rights and licences for Brazil for the Grönwall-type "Electrometall" electric shaft iron-smelting furnace. Two such furnaces, each of 3,000 kw. capacity, are at present being installed by the Brazilian company. In Europe this type of furnace has been in successful operation for some years, and of 27 furnaces installed in Sweden, Norway, Italy, Japan, etc., the total power capacity is about 99,700 kw.